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The fuel values of the food are expressed in calories per pound of food. By combining high value and low value foods we obtain a substantial ration which is nourishing and economical.—[See page 62.]

THE CALORY RESTAURANT

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Playing the German Game

WE have noticed that in certain quarters there is a growing demand for what is called a more aggressive policy on the part of the British navy. There is an evident attempt to create the impression that Great Britain's naval policy has proved to be ineffective, because it has failed to suppress the U-boat piracy. It is urged that the time has come for the British fleet to make a grand assault on the German bases, Kiel, Heligoland, Wilhelmshaven, etc. These exponents of the true strategy and tactics would have Admiral Beatty, with battle flags flying and an explosive, "Damn the torpedoes" on his lips, rush boldly through the German mine fields and, Kaiser-like, hack his way through to victory.

Well, 'twould be a thrilling spectacle; and to no one would it bring such unadulterated delight as to Admiral von Capelle and the German Admiralty. Nothing would give these gentlemen greater joy than to see the British fleet floundering in the uncharted channels and mine fields of the Bight of Heligoland and exposed to the terrific fire of the Heligoland and Cuxhaven 16-inch gun batteries.

Equally absurd is the suggestion that the way could be cleared by sweeping and countermining; for a channel would have to be opened through 20 miles of mine fields, during which operations the trawlers and destroyers would be exposed to the combined fire of the sea coast batteries and the German fleet.

But Churchill says it should be done. Well, if Churchill wants to add to the fiasco of Antwerp and the tragedy of the Dardanelles a third disaster, compared with which the Dardanelles would be child's play, he is certainly going the way to get it.

The submarine problem can never by solved by piling up the British fleet upon the impregnable sea coast defenses of the enemy. It can be solved by shutting up the U-boat fleet within the North Sea by a mine-barrier from Scotland to Norway. How long shall we have to wait for the British Admiralty to undertake this perfectly feasible engineering work?

The Shipping Board Scandal

THIS war is the greatest crisis that has occurred in all the history of the human race, and the issue of this crisis (so we are told by the Allies) depends upon the outcome of the German attack on merchant shipping. They have solemnly warned us, and surely they ought to know, that there is urgent need for "ships, ships, and yet more ships," and the question of whether they can win out in the fight depends on whether we can build merchant ships fast enough to make good the tragic losses in the world's merchant marine. They have told us, and we knew it long before they said so, that not only were ships needed, but that they must be provided with all possible speed, that we must build up to our full capacity and put a new and large fleet afloat at the earliest possible moment.

In a word, the cry which has come out of Europe is: "Give us ships in large numbers and give them to us quickly, or we stand to lose the war."

That is an urgent plea and coupled with it comes an equally urgent warning from our War Department that if we do not make haste to provide the necessary transport, it will be impossible for us either to throw our new armies into the fighting line, or maintain them when they get there.

Now these words of warning and appeal were spoken many, many weeks ago; and if we had shown in this matter a tithe of that organising and administrative genius upon which we are pleased to plume ourselves, a vast and well ordered plan of ship-building would now be under full swing and the last ounce of our ship-building energy would be applied to the task.

Great was the promise and pitiful has been the performance.

Instead of harmonious and effective coöperation, the country is being treated today, as it has been treated for several weeks past, to the amazing and humiliating spectacle of what looks very much like a personal quarrel between the two men, Denman and Goethals, to whom our President has entrusted the carrying out of our ship-building program. This scandal has reached a point where it is hard to say whether it is more lamentable or ridiculous.

It is putting the thing mildly to say that the humiliating affront to which the United States has been subjected during these past few weeks, has produced a feeling of consternation. If this is the way in which the selected and trusted leaders are going about their task, then Heaven help the United States in this great venture to which it is committed.

There is a feeling abroad that the time is ripe for the President to stop this unseemly brawl by placing the execution of our ship-building program in the hands of one man who shall be responsible to him alone. The thing was tried at Panama with brilliant results, and for our part, we feel satisfied that the success which General Goethals accomplished single-handed and unhampered by civilian interference down at the Isthmus, he is perfectly well able to repeat in the present crisis.

Censorship

A STRICT military censorship is as necessary to the successful prosecution of war as is the raising of armies, the production of war material and the creation of a general staff. Censorship and the freedom of the press will always be at loggerheads—the censor tending to cut down to the lowest limit the sum total of information that may be made public, and the Editor striving, as is his wont, to fill his columns with the largest possible amount of war news.

The point of view of each of these gentlemen is essentially different. The censor looks at the question purely from its military and political side, the Editor, however much alive he may be to military and political considerations, is tempted to judge all information that comes to his desk by the test of its "news value."

Now, we are of the decided opinion that for the successful prosecution of this war upon which we have entered, the military and not the editorial mind should have the first and last say as to what may and what may not be published. For the Government alone knows all the facts of the case, and therefore alone is qualified to decide what information should be given out to the public.

The publication of a certain fact may appear to the lay mind to be perfectly harmless, whereas to the mind of the censor, because of certain collateral facts which he alone knows, such publication would be fraught with very great danger. A case in point was the announcement in the daily press of the arrival of the first contingent of American troops in France, at a time when the second contingent was still several days' steaming from port. The safe arrival of the troops seemed naturally to preclude all need for further secrecy; but to the censor, who knew that several transports with their priceless freight were still out on the Atlantic, such publication was a notification to the U-boats that a large and valuable part of their quarry was abroad in the danger zone.

There is but one attitude for the press of this country to assume, and that is one of loyal acceptance of the inconveniences and restrictions of a military censorship. This is one of the burdens and sacrifices of war. Let us endure it cheerfully. Above all, let us not add to the distractions and worries of our Government by adopting an attitude of constant and carping criticism.

Less Zeppelins, More Aeroplanes

FROM that fertile bed of rumors, Switzerland, comes the report that Germany, admitting the military failure of her Zeppelins, has decided permanently to abandon the construction of these aerial leviathans. There is sufficient reason to place credence in the report; so many Zeppelins have met an untimely fate in this war and so costly have been the last Zeppelin raids over English territory that even the Germans themselves must by now realize the extravagance of their expectations in this direction.

At first thought it would seem that this momentous decision, taking it for granted that it is a bona fide one, simplifies the task of the Allies. As a matter of fact the reverse is the case, for it is no doubt the intention of the German government to turn the Zeppelin plants and their skilled workers over to the manufacture of aeroplanes. No reliable information is available regarding the extent of the Zeppelin works, although it may well be imagined that these are far more extensive than they were previous to the war. Conceivably these plants, with slight rearrangement, can readily be turned into aeroplane factories, and their personnel should require little training to adapt them to the new work in hand. The excellent engines used on the Zeppelins are today available for use on large German battleplanes, despite their rather large size; so that the aeroplanes turned out by the converted Zeppelin factories are certain to have engines awaiting them in the desired quantities—engines which are second to none in point of reliability. Much which goes into the construction of a Zeppelin will henceforth be available for aeroplanes; indeed, material which would have gone to make one Zeppelin will now go to make a number of aeroplanes.

It would not be surprising if the output of Zeppelin factories should weigh heavily in the fight for aerial supremacy in the near future. Perhaps it is already felt, for there is a marked increase in the number of German machines in the air on the Western front at this writing. At any rate, the abandonment of the Zeppelins by the Germans is bound to find expression in a greater production of aeroplanes, which will have to be met by the aircraft constructors of the Allied countries and ourselves. Previous to the conversion of the Zeppelin plants Germany was able to maintain an aircraft production numerically equal to that of her opponents, and naturally her output is now greatly augmented. Aerially, Germany is a powerful, aggressive enemy, and it will now, more than ever before, take the untiring efforts of the Allies and America to gain and maintain a decisive control of the air.

A Board of Military Inventions

A BILL has been placed before the House of Representatives providing for the creation in the War Department of a body to bear the above title, whose duties shall be "to seek, receive, inquire into and assist in the development of inventions, inventive proposals and inventive ideas of possible military value to the United States." It is proposed that this board consist of five members to be appointed from civil life and to serve without pay other than expenses incurred. Since it is provided that the board shall meet "from time to time in Washington or elsewhere at the call of the chairman or the Secretary of War," it is evidently not contemplated that the members give their entire time to the work. Apparently they are designed as a sort of advisory or consulting group, placing the "special knowledge of some industry or science" which it is specified that they possess at the temporary disposal of the Government when called for.

It is certain that all the details of this proposal will not meet with general approval. Thus we have already received a lengthy communication from a successful inventor of repute, who bewails the obvious intention which he sees behind this bill of placing a hand-picked group of confidential men from big business in a position where they can pass upon, discourage and appropriate inventions, and in general divert ideas into the corporate channels with which they are identified. Perhaps for a fact it would be better to make this a paid board, a regular adjunct of the Government, with the members giving their entire time to the service. Perhaps it is true that business interests will tend to sway the decisions of men who can afford to give their services under the provisions of this bill. Perhaps it is true, as our friend whom we have already quoted insists, that only the inventor himself can be sufficiently free from the discouragement induced by preliminary and partial failures to give his invention that thorough-going persistent trial, with all the alterations and modifications suggested by each test, which lies behind the ultimate success of aeroplane, internal combustion engine, and a host of other modern developments. Perhaps this gentleman is correct in his conviction that the operations of this board can only result in a perfunctory trial of inventions which will cause the turning down and eventual loss of many valuable ideas.

The fact remains, however, that some sort of a body is essential to handle the mass of suggestions which our inventors, professional and amateur, are putting forward. No governmental agency has existed whose proper function it is to do this, although in the absence of such agency the work has fallen indiscriminately upon the shoulders of Army and Navy Boards which might better be doing something else, and of the Council of National Defense and its advisory bodies. We have even done a good deal of it ourselves in a wholly quiet and unofficial way, and we suppose every technical man who has an audience of any kind has been called upon by the members of that audience to tell them whether their ideas are valid, and if not why not. But while all concerned have been willing to give their time to this work, it is after all work which every consideration of efficiency, economy of effort, and full coördination of related items demands should be concentrated in one place.

Accordingly, however imperfect a first step it may turn out to be, we welcome the effort of this bill to provide such an agency. Many of the defects which the bill probably possesses can doubtless be identified and remedied before passage; others will reveal themselves only through the operation of the system. In any event the bill represents a distinct step toward rational handling of the nation's conscripted inventive ability, especially since it is clear that the board as proposed will be free from Army and Navy ultra-conservatism which so many people see as a bar to progress.

Invention

A Detachable Observer's Car for use on tractor aeroplanes has recently been patented by Louis Bechereau of Paris, France, and assigned to the constructors of the well-known Spad machines. The observer's car is attached in front of the propeller, in an overhanging position, support being afforded by connecting with the propeller shaft and a part of the landing gear. Truly, this is an odd aeronautical device; but in all probabilities the inventor has had ample experience in aviation and knows that his idea is practical.

A Tobacco Box with Match Safe.—Inventors of late seem to be determined to keep matches where the smoker can find them. Recently there appeared in this column a description of a pipe which carries a match safe in its stem. Working along these lines a New Yorker, Louis Stankewitz, has secured a patent on a tobacco box which contains a match safe. The tobacco box is provided with a rectangular recess in which a layer of paper matches is placed, and a spring-operated flap which covers the recess ordinarily.

Irrigation System for Flower Pots.—Comprising a circular closed tank provided with a filling opening in its top, an adjustable feed mechanism, a feed tube and an opening, and designed to be placed on the upper edge of the usual flower pot with the plant coming up through the center hole, the automatic watering device patented by Paul R. Weitzel, 2d, Philadelphia, Pa., is of interest. By means of a needle valve the water contained in the circular tank can be fed at a constant rate of flow to the roots of the plant, thus relieving the owner from the task of watering the plant at regular intervals.

A Salt Shaker that Never Clogs.—By providing his salt shaker with a number of pins which work in the orifices of the top in such a manner as to keep them clean at all times, Gotthard L. Lofstrom of Rockford, Ill., appears to have solved the problem of the salt shaker that never clogs. Briefly, his invention consists of the usual salt-shaker top, to which he adds a casting below, a disk movable in this casting and provided with pins which project into the orifices, and a weighted lever which operates the disk through the latter's stem member. Thus the pins move in and out of the orifices as the shaker is used, facilitating and assuring the passage of salt.

A Soldering Iron Which Carries Its Own Solder has recently been invented by Ray M. Tilton of Panora, Iowa. In external appearance his soldering iron is like the conventional tool, but when examined it is found to consist of a hollow shank with an iron at one end, a hollow handle at the other, which is arranged as a magazine to hold pellets of solder, and a suitable means of delivering one pellet at a time to the iron. A small orifice permits the melted pellet of solder to flow from the base of the hollow shank to the tip of the soldering-iron surface. In operation the releasing device is depressed each time more solder is required, whereupon a pellet is fed; the pellet, falling into the hot soldering iron, melts and passes out through the orifice to the copper surface.

A Protective Helmet which May Be Used as a Trench Tool is among the latest inventions due to the present war. The present helmet is the invention of Leonard D. Mahan, of Washington, D. C., and consists of a scoop-shaped shell having its cavity formed with a head-receiving portion and a longitudinal extension beyond, which terminates in a handle, the inner surface of the shell being free and unobstructed, and means for securing the helmet to the head. All in all, the helmet should afford protection comparable to that of other steel helmets now in use; and the additional feature of its usability as a trench tool makes its use advisable, since assaulting infantry must "dig in" wherever they happen to find themselves and for that reason are compelled to carry trench tools. Combining such indispensable accouterments as the steel helmet and trench tool in one should serve materially to reduce the equipment of the modern infantryman.

Automatic Film Winder for Hand Cameras.—While it is true that the amateur film camera of today has been developed to a point where it is merely necessary to "press the button" and the rest of the photographic process practically takes care of itself, the fact remains that the film must be turned following the pressing of the button. If this is not done the next exposure is superimposed on the first, and the two exposures are ruined. With a view to eliminating the bother incident to turning the film, Ralph H. Moore and Ray P. Saffold, co-inventors of Douglas, Ariz., have patented an automatic film-shifter for cameras. Briefly, their device consists of a spring mechanism for shifting the film to bring a new surface into position, and a means for connecting this mechanism with the shutter so that it will operate immediately after the functioning of the latter. With this mechanism in use it will become possible for a photographer to snap two or more views in quick succession, which is often desirable but not practicable with the present manually-wound film cameras.

Science

The Control of Infantile Paralysis.—A series of recommendations concerning the control of poliomyelitis were adopted by the Conference of State and Provincial Boards of Health of North America at the meeting held in Washington, May 2d and 3d. The use of travel certificates was not recommended, but travel and contact with children during an epidemic should be discouraged. Surveillance of persons coming from infected districts was thought unnecessary, except in the case of a person who has been definitely exposed to infection. A most effective agency in the control of the disease is stated to be the employment of public health nurses, who, in coöperation with the physician, will teach sick room precautions, the necessity for rest in bed, and the need of proper support for affected parts. The recommendations cover various other details of the subject.

Temperature Observations on Plants.—Dr. D. T. MacDougal, of the Desert Botanical Laboratory at Tucson, has recently reported some observations on the relation of temperature to the rate of growth in plants. Growth includes a number of separate processes, each of which goes on at a rate modified by the temperature, by the amount of material brought into the chemical reaction involved in the phenomenon, and by the concentration of the products of the reactions; hence there is no simple relation to temperature alone. Observations on the growth of an etiolated shoot of Opuntia in a dark room brought out the interesting fact that growth may occur in this cactus at the high temperature of 49 deg. C. (120.2 Fahr.). Moreover, the plant endured for half an hour a temperature of 52 deg. C. (125.6 Fahr.), and subsequently resumed growth at 49 deg. C.; and joints growing under natural conditions were found in one case to have a temperature of 55 deg. C. (131 Fahr.), though it has heretofore been supposed that such temperatures were fatal to phanerogams. These temperatures were not those of the surrounding air, but of the plant tissues, as measured with special thermometers of the "clinical" type, the thin bulbs of which were inserted in the plants. It was found that the temperature in the interior of growing shoots of cacti are sometimes 8 or 9 deg. C., higher than that of the air.

Latest Measurements of the Aurora Borealis.—The December, 1916, number of *Terrestrial Magnetism* contains two important summaries of recent measurements of the aurora made in northern Norway; viz., those made by Störmer at Bossekop in the spring of 1913, and those made by Krogness at Haldde in 1913 and 1914. In both cases, besides the main stations at Bossekop and Haldde, respectively, there were secondary stations at points a few miles distant, as the method of measurement involved simultaneous photographs at two stations. Störmer measured the altitudes of 2,500 points in auroras. Vegard, at the University of Christiania, has worked up 415 pairs of successful parallax photographs taken under the direction of Krogness. The upper limit of the aurora is found to vary from about 100 kilometers up to 330 kilometers. The altitude of the bottom edge of auroras is remarkably uniform, rarely departing more than a few kilometers from the average, which is about 108 kilometers (67 miles). No aurora extended lower than 85 kilometers. There were two well-defined maxima of occurrence; one at about 100 kilometers and one at about 106 kilometers. These maxima seem to remain unaltered from year to year, and suggest the conclusion that a predominant part of the cosmic rays coming from the sun and producing the aurora are made up of two groups, each of which has its own quite definite penetrating power.

Recent Observations in Volcanology.—Dr. A. L. Day, in the last report of the Geophysical Laboratory in Washington, records the rare opportunity afforded by the eruption of Stromboli during the autumn and early winter of 1915, to observe a stream of incandescent lava in contact with water, the lava having flowed from the principal vent of the volcano into the sea. Both in this case and at Sakurajima, in 1914, liquid lava was observed to continue its flow under water without explosive violence, or indeed any manifestation whatever, at the surface of the water, of what was occurring below. "A quickly cooled porous sheath of quasi-flexible, vitreous lava forms about the stream, which is sufficiently non-conducting to confine the great body of heat within the flowing stream and release it gradually. The immediately adjacent water showed but a few degrees' rise in temperature." Another noteworthy result of the Stromboli eruption was the removal of the long standing fallacy that the density of the cloud emerging from the crater of a volcano is a measure of the activity within. The approach of a cold moisture-laden wind causes an immense apparent increase in the volume of the emerging "smoke," which is really nothing but condensed moisture. In short, the amount of "smoke" issuing from a volcano depends largely upon atmospheric conditions, and the practice of keeping a continuous record of the apparent volume or height of the cloud from day to day as a measure of volcanic activity is based upon a misconception.

Electricity

Showing One's Buttonhole Colors in the Dark is made possible by a novel electric novelty recently introduced. It consists of a translucent celluloid button containing a 2.7 volt electric bulb, and a cord with socket and plug. The plug is inserted into the receptacle of the usual flash-lamp case, and upon pressing the button the flag is illuminated in a most startling manner. This electric novelty is proving most popular.

Detecting Breaks in Transmission Lines by Wireless Means.—On three occasions, states the *Electrical Review*, breaks in the transmission lines of a local power company have been discovered by the Chattanooga Wireless Club of Tennessee. It appears that when the aluminum transmission lines part, the arc momentarily created causes a hissing sound to be heard in the wireless stations of the club members, thus giving warning of the break.

The Largest Self-Cooled Transformers.—A leading manufacturer has recently built six of the largest self-cooled transformers in the world, aggregating 48,000 kilovolt-amperes, for a steel company. They are single-phase, 25-cycle, 8,000 kilovolt-ampere units each and step the voltage from 44,000 to 6,600 volts. There are also taps for 6,930 and 6,270 volts. The design of these transformers incorporates the circular disk coil, interleaved windings and three-legged core. A unique feature is the construction of the 24 radiators external to the containing tank, giving a radiating surface approximating one million square inches. Cooling is obtained by an automatic circulation of oil through these radiators. The new radiators have introduced a new order of transformer ratings.

A Remarkable Case of Resuscitation after Electric Shock is narrated in a recent report of an inspector of a New York power company, which gives particulars of the recovery of one of his men from the effects of an electric shock. The man, when about to erect primary wires, was apparently killed by accidentally touching a wire carrying current at 2,300 volts. A lineman immediately took hold of the ankles of the limp body, lifting it until the whole weight rested on the neck, and letting it fall. He then took a pair of connectors and hammered the soles of the injured man's feet without removing his shoes. Another lineman opened the man's mouth, pulled forward the swallowed tongue (which occurs in electric shock), and was about to begin the Schaefer prone method of resuscitation, when the man returned to life. He was removed to the hospital, and is now well, though suffering severely from his burns. Similar cases of recovery are mentioned in connection with the plan of striking the feet without removing the boots or shoes in case of electric shock.

Electrical Equipment on Hospital Ship.—The new Mesopotamian hospital ship, which has been christened "The King's Ship" and is intended for use on the Tigris, is provided with electric lighting and power plant, and every conceivable type of electro-medical apparatus that is considered indispensable to the proper care of the British wounded. The vessel is a complete floating hospital, with beds for 180 cot cases and accommodations for minor casualties, a fly-proof operating theater with electric sterilizing apparatus, lifts to enable serious cases to be moved from one deck to another, isolation rooms, and so on. The system of ventilation is designed so as to keep the vessel cool in the maximum summer temperature and warm in the autumn and winter. For the summer, rotating electric fans have been fitted at an average of one to every four beds, while currents of cool air are pumped through apertures in the various decks. There is a refrigerating chamber with plants for making ice- and soda-water, distilling water and so on. The boat is oil-driven, but lighted throughout by electricity.

Electrical Indicators for Level Crossings.—At the crossing of the Nashville-Memphis main line with the Illinois Central line to South Memphis, according to the *Railway Gazette*, an all-electric signaling plant has recently been installed. Signal lamps are operated from a 110-volt alternating-current supply, but for the mechanism and control direct-current is used. Emergency power is supplied by an Edison storage battery consisting of 90 cells of 150-ampere-hour capacity. Poplar Boulevard, which crosses all four railroads, is a street on which there is a dense traffic, many motorists using it, especially at night. Realizing that the occupants of automobiles might frequently fail to hear the ringing of the ordinary crossing bell, and fail to note the approach of trains, a signal of the Brach type was installed—the "automatic flagman." This gives both a visible and an audible warning. It contains eight stationary electric lamps with red lenses showing down the street in both directions. These lamps are automatically lighted one after the other in a manner to give the effect of a swinging red lantern. Above the lights in large lettering is the sign "Railroad Crossing," and a large locomotive-type bell, which sounds as trains approach.

The Submarine Problem—IX.

The Net as a Weapon of Offense

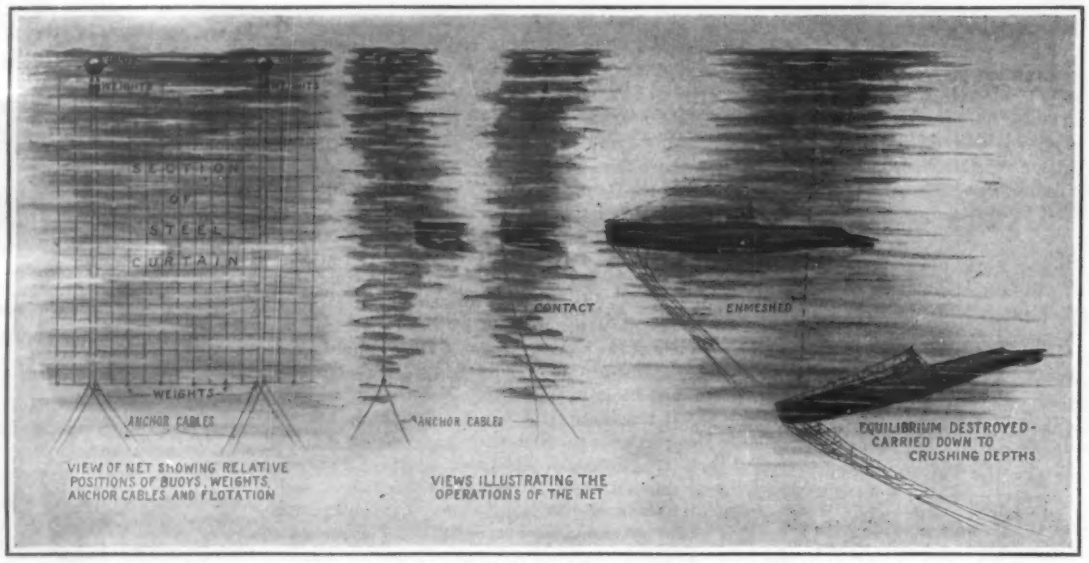
ALTHOUGH it is our belief that the only effective answer to the submarine would be to build a bomb-curtain clear across the North Sea, there are many other more limited applications of the net which have proved to be efficient in actual service, and others which would well warrant a trial in shallow channels or in various locations where the submarines are liable to be encountered in considerable numbers.

We give in the present article two illustrations of submarine nets, which, after some experimental work, would doubtless prove to be very efficient. The first of these devices is one which was submitted to this office by Mr. Walter Wellman, of the Wellman Arctic Expedition. He proposes to build a stout net of steel cable in sections of convenient length, each section to be practically independent of its neighbor. Each section is loaded with heavy weights at the top and with lighter weights at the bottom. The heavy weights (and therefore the top of the net) are attached to flotation buoys by a connection which is sufficiently strong to carry the loaded net and withstand the stresses due to the scend of the sea and the tidal currents, but is not sufficiently strong to withstand the pull which comes upon the net when an 800-ton submarine runs into it at a speed of 10 knots.

When the submarine hits the net, the latter is torn away from its supporting buoys, and as the center of the net is carried forward, the upper part, with its attached weights sinks and folds over the forward half of the submarine, as shown in the diagram.

Now, a submarine, when running below the surface, is in a condition of very sensitive equilibrium, and it has only a few hundred pounds reserve buoyancy. Hence the load suddenly imposed upon the forward end of the submarine by the weighted net destroys the fore and aft trim, depressing the bow; and before the submarine can be stopped, or the equilibrium restored by means of the hydroplanes and trimming tanks, it will have plunged down to depths at which it will be crushed in by water pressure.

This principle of upsetting and sinking the submarine by dropping a heavy weighted net across its forward half is something new and seems to be well worthy of a trial.


SECTION OF STEEL CURTAIN
WEIGHTS
ANCHOR CABLES
VIEW OF NET SHOWING RELATIVE POSITIONS OF BUOYS, WEIGHTS, ANCHOR CABLES AND FLOTATION
CONTACT
ENMESHED
ANCHOR CABLES
EQUILIBRIUM DESTROYED - CARRIED DOWN TO CRUSHING DEPTHS
VIEWS ILLUSTRATING THE OPERATIONS OF THE NET

In this type the submarine tears a weighted net loose from its supports. This load and the drag of the net anchors carry the submarine to the bottom

The other submarine-destroying net has been sent to us by Mr. A. M. Sanborn, of California. This device consists of a comparatively light net of large mesh made up in several units, and supported from a buoyed cable. At every 10-foot interval (the mesh being 10-foot) the net is supported from the buoyed-cable by a pair of light hemp "break cords," which have sufficient strength to hold the net but would be broken by the strain put upon them if the net were carried away by a submarine.

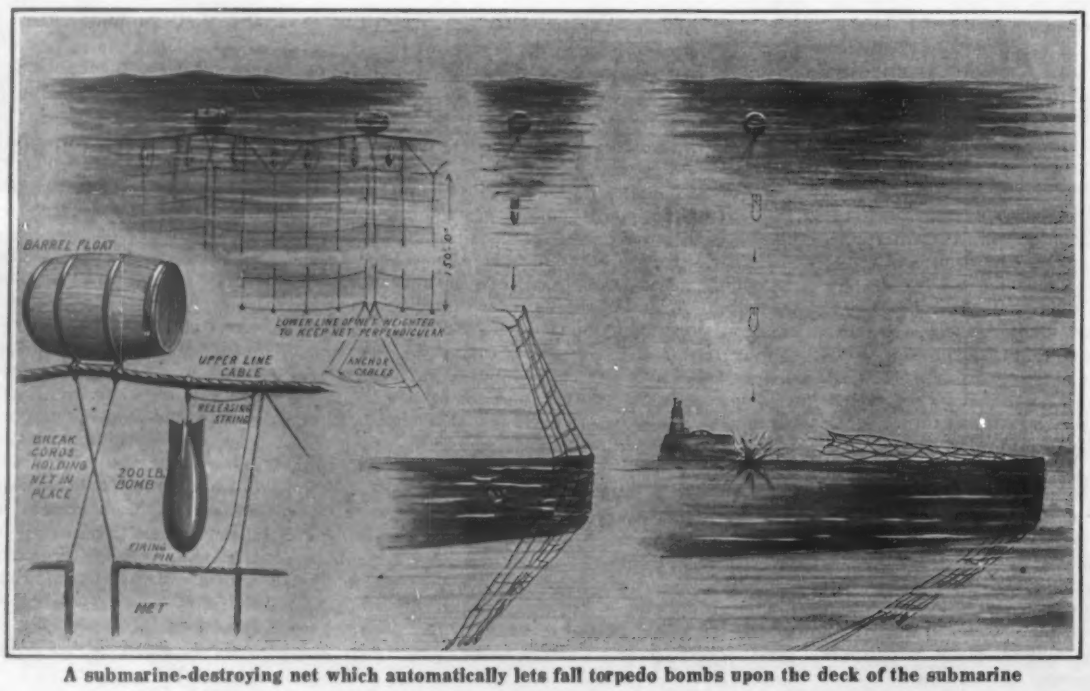
Suspended from the cable and held in place by release strings is a series of torpedoes or bombs, each carrying enough explosive to make sure of wrecking any submarine if contact were made. In the nose of the torpedo is a firing pin, and at the rear are vanes to steady the torpedo in its downward flight.

When a submarine strikes the net and brings a heavy strain upon the break cords, the latter are severed, and as the net is carried forward it pulls on the release strings and releases the torpedoes, which drop vertically end on, and are exploded on contact by the action of the firing pin. Since the German submarine is about 30 feet in width, it is certain that at least three of the torpedoes would strike the hull at approximately the same distance from the bow, and if so, its absolute destruction would be assured.

The pull on the release string not only serves to set the torpedo free from the supporting cable but it also opens certain valves which admit water and increases the negative buoyancy of the torpedo. It is fairly certain that if the submarine was traveling at a depth of 30 to 50 feet, and at a rate of 5 to 10 knots, the torpedoes would strike home before the 250 feet of the submarine's length had passed clear of their line of flight.

The valuable feature in both of these devices is that they are entirely automatic and self-contained and their work is done independently of the patrol fleet; that is to say, the nets do their own killing. In the first place it is necessary only to provide sufficient weight on the loaded net to insure a quick dragging down of the nose of the submarine when the net, torn loose from its buoys, falls upon it. The other plan has the valuable quality that one at least of the bombs is certain to strike the plating of the interior pressure-resisting hull, thereby sinking the submarine.

In each case it would be advisable to anchor the nets, either from top or bottom; or they might be held in position or towed through infested waters by tugs and trawlers. A fruitful field for their employment would be found at the exits from the submarine bases, particularly at the mouth of the Elbe, and the approaches to Wilhelmshaven and Zeebrugge.



A submarine-destroying net which automatically lets fall torpedo bombs upon the deck of the submarine

REPORTS reaching our shores from the submarine zone persist in creating the impression that the menace is well in hand, if not completely stifled, by means of the devices and the methods now employed. Doubtless the combined American and Entente naval forces have found numerous effective ways of dealing with the U-boats. Conceivably, the need for ideas is not quite so urgent as it was six months past. Nevertheless, American inventors must not consider their work completed; they must continue to work on their schemes with redoubled efforts. For one thing the Germans find countermeasures for many of our devices after a while, and so we must maintain a constant supply of fresh ones to take the place of those rendered impotent by a wily enemy. Above all, it must be borne in mind that every idea and every suggestion aids toward making our campaign more effective. The plans herewith shown prove that this field of invention and experiment is by no means exhausted.

—EDITOR.

The Heavy Shall Rise and the Light Shall Fall

Flotation the Metallurgist's Version of the Famous Scriptural Paradox

METALS occur free in nature so seldom as almost to justify the use of the word, never. Practically without exception they are found in chemical combinations ranging from the simple oxides and sulphides of single metals to the most complicated double and triple silicates and carbonates and hydroxides. Moreover, it is seldom possible for the miner to turn over to the metallurgist a body of ore consisting of a single uniform chemical substance, free from all impurities and non-metal-bearing earths. Far more usual is it for the material delivered at the mouth of the mine to consist of but five or ten per cent of metal-bearing rocks and the balance dross or gangue, as it is called by the man that has to handle it.

The problem of the metallurgist is then a double one. He must first sift out the gangue from the ore by any one of a number of processes coming under the general head of concentration. This means just what its name signifies; that since it is not profitable to carry a heavy percentage of non-productive material any further through the work than necessary, the first step must be to eliminate as much of this as possible, thus concentrating the metal-bearing portion of the ore for further treatment. It is an essentially mechanical process, a sorting out of the crude ore into what is workable and what is not. The concentrate then passes through the chemical process of smelting, in which it is torn apart and recombined in such a way as to leave the pure metal out in the cold while the

carbon and oxygen, the silicon, sulfur and chlorine, and all the other elements present in the ore or introduced as reagents, are shuffled about into new alliances.

One way to sort things out is to pick them over with the hands. This would be all very well if it were a matter of sorting regular ingots of pure metallic copper or iron from a mass of granite and quartz boulders. But this is not the problem of concentration. In the very richest deposits the metal does not occur in homogeneous masses, but rather scattered through and through veins of non-metallic rocks. So the first step in concentration must be pulverization; and then the problem is reduced to that of sifting out, from the many tons of heterogeneous finely powdered rock dust, the few tons which contain iron or copper. For this no direct manual process is available, and mechanical aid becomes necessary. Up to the past 15 years or so, the generally accepted method has been separation by weight; in some way gravity has been forced to pick out the heavy particles and reject the light, or vice versa.

At least one example of this must be familiar to all. No school history of the United States is complete without a picture of a bewhiskered and flannel-shirted Forty-Niner separating a California river from its gold with the aid of an ordinary dish-pan. In this case the pan, filled with sand and water, was gently rocked back and forth; and while the heavy gold-bearing particles refused to leave the bottom, the lighter sand and gravel gradually floated up under this agitation and were slopped over the edge and out. Of course this is but one of scores of ways in which a mixture may be separated into its constituent parts according to their weights; and until the idea of flotation was developed these fairly monopolized the field of concentration. Now, within its proper limits, which will be brought out later, flotation is king.

What, then, is this mysterious process? The word is familiar enough to any well-read person; and such a one would undoubtedly realize, in a general way, that it refers to some procedure, comparatively new, in metallurgic technique. Little effort, however, has been made to tell the man in the street just what it is all about—hence this discussion.

Flotation, to quote one technical writer, is concentration upside down. That is, the heavy mineral ore is made to rise, while the lighter gangue falls. This mysterious consummation is brought about by the surface tension of a liquid, or by the tendency of liquid film to adhere to certain surfaces. While some attention has been paid to "film flotation," in which the

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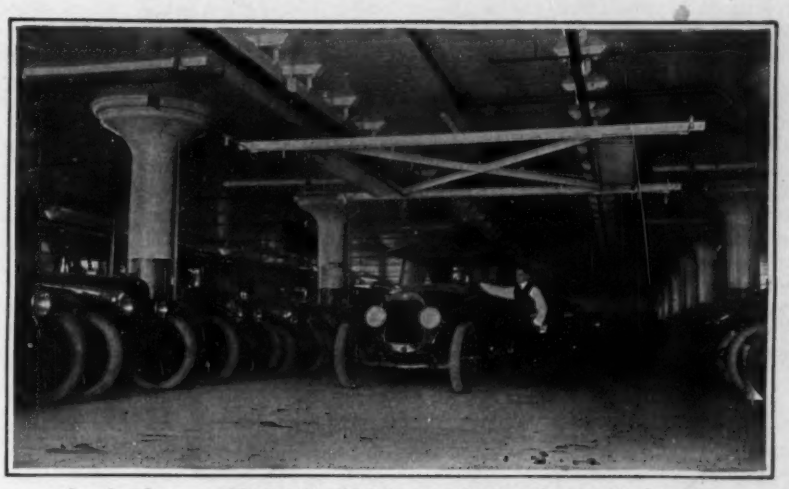
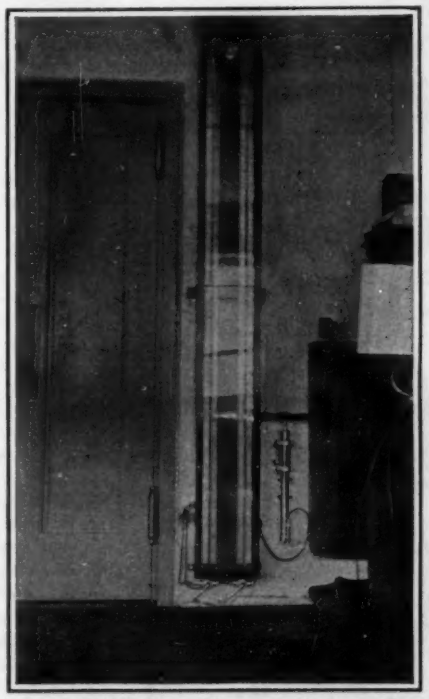
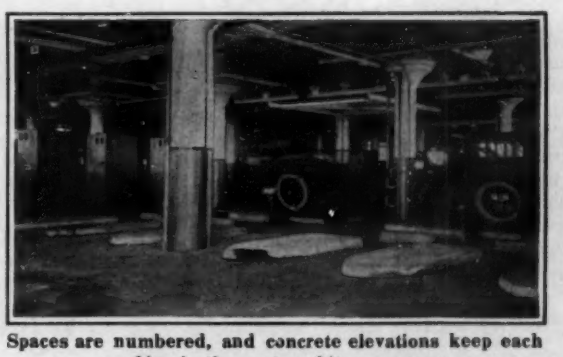


Overhead car-washing outfit which is moved out on its overhead tracks

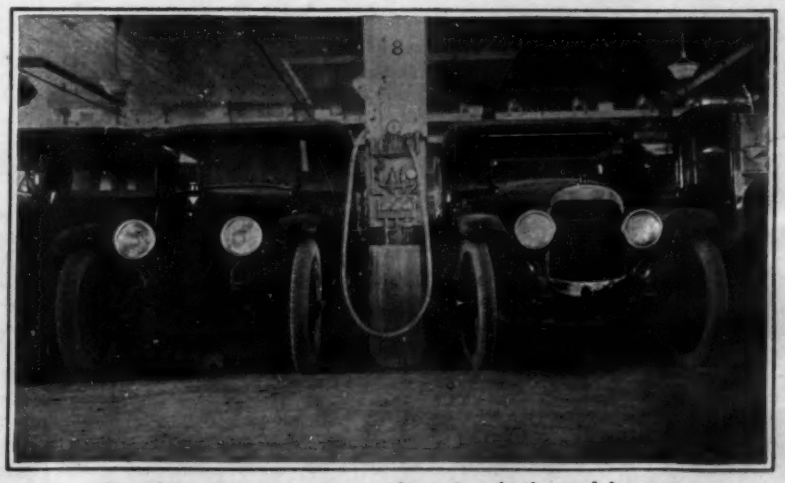


Tubes which indicate the amount of gasoline in the 11,700-gallon tanks

Ramp between the floors, showing the fire door at the lower entrance



Spaces are numbered, and concrete elevations keep each machine in the center of its own space



One of the air-pressure gas supply stations in the model garage

The Last Word in Garages

A GARAGE that accommodates 600 cars has just been opened in New York city, but big as it is, the size of the structure is of less interest than the numerous practical improvements that make for the safety of the machines and the convenience of the patrons.

First of all, fire danger is eliminated by construction of concrete, steel and masonry, and in addition to this there is an elaborate system of overhead sprinklers. Fire doors that close automatically by the melting of fusible links, separate the different floors. The gasoline is stored in huge tanks in the basement and delivered by air pressure direct to the car, so that danger from carrying about pails of fuel is done away with. Finally, the precautions against carelessness extend even to the use of trash boxes of metal with air-tight covers that are self-closing, so that no accumulation of oily waste or papers will start a conflagration.

Next to safety from fire danger, perhaps the first consideration of the business man is the saving of time by some of the modern methods in this carefully planned garage. The delay in waiting for elevator service is done away with by a system of ramps that extend from the main entrance and serve the four floors. These 20-foot inclines of reinforced concrete run in a straight line to the third floor, thence at a right angle to the fourth floor. The grade is from ten to fifteen per cent and as the width is ample for two cars to pass, there is no difficulty or risk in passing machines up and down. Slight elevations in the center of the ramps serve to keep the cars to the right side, avoiding the danger of collisions. By using the ramps, a car can reach its space on any floor in less than a minute from the street. A saving was effected in construction and upkeep, as well as this great saving in time, for the owners state that more than $18,000 a year is cut from their expense account by the use of ramps instead of elevators.

Another time-saver for the busy man is the free bus that runs between the garage and the nearest subway express station, so that if he drives his own machine it is not necessary for him to walk back to the station after leaving his car. Other time saving conveniences are the electric signals that flash the number of a car wanted from the office to the different floors. The system used is the same as that employed in calling cars to a theater entrance. The car number is flashed upon boards that can be seen from all parts of the different floors, and at the same time a bell calls attention to the signal.

A thorough checking system accounts for the car from the moment it enters the main entrance. A watchman notes the number as the car enters and leaves, and a report of its movements is sent to the owner at intervals. This prevents the use of the machine by a chauffeur without the owner's permission.

The confusion which may be found in some garages, when cars are shifted about to accommodate a rush of business is avoided in this new establishment by a simple but efficient device. Each machine has a space for its exclusive use. This is marked by a number overhead, and can be entered direct from the wide passage ways. In order to prevent crowding or scratching by accidental contact, the cars are run over concrete elevations of such size that the wheels just straddle them. Each car space has such a concrete guide, shaped like the long section of a big shell, with the pointed end at the entrance. Other concrete elevations back of the square end serve as buffers to keep the wheels from going too far. The spacing is planned so that even a careless driver cannot collide with a machine in the neighboring "apartment" while entering or leaving, as there is fourteen inches room between the running boards when the cars are housed.

Each patron secures the use of an individual steel locker, and these are grouped about the various floors in convenient locations to their corresponding car spaces.

The stations for supplying gas to the car are placed at intervals on each floor. Connection with the two tanks in the basement is by pipes, and the fuel is served by air pressure and at the same time accurately measured. Compressed air is served at various stations and there is an abundance of water. Accessories and supplies are sold in a completely stocked department on the main floor.

One of the unique features of this garage is a portable car washer, a number of which may be found on each floor. The device is a frame that runs the length of the passage ways on an overhead crane, so that the car can be cleaned beside its own space. The frame carries several lamps to throw light upon the machine from various angles and it is provided with lengths of hose that carry warm and cold water. A vacuum system is provided for removing the dust from car interiors and upholstery.

Another device not found in other garages is a meter for determining the amount of fuel in each of the tanks, that have a capacity of 11,700 gallons each. It resembles a gigantic barometer with a tube that corresponds with each tank. The number of gallons is indicated beside the tube, and pressure of the contents of the tank causes the liquid to rise or fall to the corresponding figure. This apparatus is located in the office, and tells at a glance just how much gas is on hand. The fuel is delivered direct to the tanks through pipes, and may be passed from the street from tank trucks, or from boats on the river or from tank cars on the railroad siding.

In order to prevent discontent and labor troubles among the chauffeurs, elaborate quarters have been established for their comfort. Rooms on the top floor are fitted up as a library, writing and reading room, restaurant, pool parlor, barber shop and shower baths; while the roof will serve as a recreation ground. A free employment bureau for chauffeurs forms a desirable feature of the "club." These advantages serve as a compensation for a strict "no commission" rule on the part of the management.

Strategic Moves of the War, July 19th, 1917

By Our Military Expert

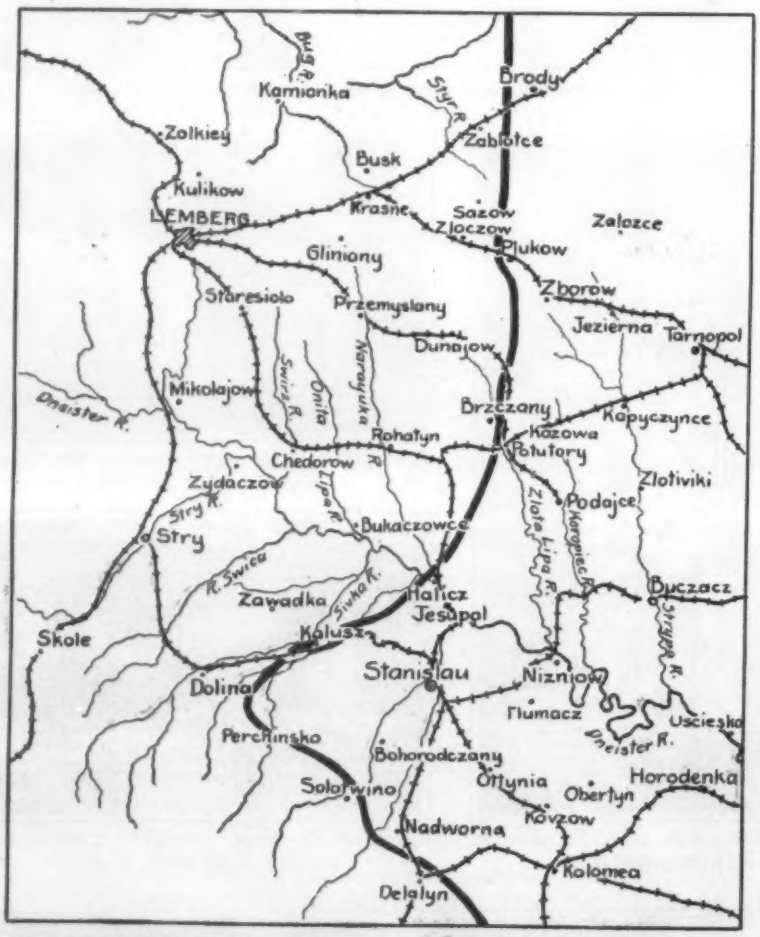
RUSSIA has come back evidently to take a leading part again in the war; her recent and wonderful activities may cause soon an entire re-arrangement of the German plans and will undoubtedly force a return to the Russian front of many German divisions that have been transferred elsewhere. If estimates can be relied upon, twelve or more strong German divisions (about 240,000 men) have been shifted in the past two months from the Eastern to the Western front and eleven weak ones (about 175,000 men) sent in the reverse direction. The strongest concentration of these troops has been along the Kovel-Vladimir-Volynski lines in Volhynia and on the front to the south in Galicia. Here the lines are said to be doubly as strong in men as those in the Pripet Marshes around Pinsk and to the north along the Dwina River. But if the recent Russian successes in the vicinity of Lemberg continue, it will be necessary for Germany to face the very difficult problem of reinforcing again this Eastern front against the reorganized and revitalized Russian armies.

This return of Russia is a great fact; it leads to the belief that some day it will be a landmark in the world's history. It is certainly today a surprise to the world at large and shows that the effects of the revolution upon the morale of all troops in the field may have been much less than has been imagined. The brilliant successes of Russian armies a few days ago in front of Tarnopol, around Zloczof and Koniuchi had led to the belief that the advance on Lemberg would be made along the line of the railroad through Krasne to the northeast of that city. But the more recent offensive of General Brussiloff's forces has broken the Austro-German line at and to the south of Halicz and west of Stanislau and has penetrated the defensive positions of the Austro-German armies as far as the Lomnica River at Kalus. By crossing the latter river and taking the line of heights on the north bank that run from the Dniester River almost to Kalus, this defense line where the enemy would have been expected to make a stand was relinquished by the defeated Central Allies and was taken by the victorious Russian troops. The latest reports state that the Russians have, however, given up the western bank of the Lomnica at Kalus and have withdrawn to the eastern bank; this move is probably due to floods and consequent inability to obtain supplies.

The Russians now appear to be making, in general, progress in the direction of Dolina, from which railroad junction it will be possible to move toward Stryi on the north or toward the passes in the Carpathians to the south. The Austro-German forces have practically been split into two great parts, those in the north being pushed back against the lines on the Zlota Lipa River toward Brzezany, while those to the south are crowded into the Carpathian foothills. Communications between the two parts can now be only by very circuitous routes. There is every indication that the Russians will strike in the near future in both directions, especially as it seems probable that aid can be rendered by the Rumanians from Rumania proper and from southern Bukowina. If the attacks can be forced both south of the Carpathians and in Galicia north of Halicz, there would be a break in the Central Allies' lines of one hundred miles or more. So that Lemberg, of which so much has been said, may not be altogether the object of the present grand operations; the campaign is certainly extending southward, for attacks are being made all along the front to and along the Carpathians, especially around the headwaters of the Zlota Bistritza River.

No doubt the Russian commander has in view the penetration of some of the principal passes and an entrance into the Hungarian plains as an ultimate object. The chief passes into Hungary lie a short distance to the west or to the southeast of the present field of operations. In the vicinity of these operations are several passes through the mountains, the two principal ones—the Jablonica and Beskide passes—being traversed by railroads. North of the Dniester furious counter attacks by the Austrians and Germans have been made to wrest from the Russians the positions won last week in the vicinity of Brzezany. These positions are of immense strategic advantage to the Russian advance along the whole line, for it is now impossible to transfer troops from this region since the Germans cannot afford to weaken that part of the front on account of the continued Russian pressure there. So far the attacks have met with little or no success. Still further north there has been heavy fighting around Pinsk in the great Pripet marshes and swamp regions of White Russia and even along the Dwina to the Riga front. These operations are, however, probably made only to draw attention from the grand operations farther south.

Developments of the last few days have shown the strategy of the Russian commanders; by striking first to the north, not only were positions gained but Austro-German reserves were hastily brought up as supports for that part of the line, it being evidently thought that the advance on Lemberg would be made from Tarnopol through Zloczof and Krasne along the railroad. By the sudden shift to the south and moving from Stanislau to Halicz, Kalus, and the north bank of the Lomnica, the lines of the Zlota Lipa and other defenses north of the Dniester have been outflanked and must be abandoned; the defense of Lemberg itself must then be made along the hills—about eight or ten miles east of the capital.



Scene of the Russian movements in Galicia—If the attacks can be forced both south of the Carpathians and in Galicia north of Halicz, there would be a break in the Central Allies' lines of one hundred miles or more

In itself the capture of Halicz has as much sentimental as military value since it was so stubbornly fought for by the Russians last summer without success. Its capture and the advance across the Lomnica River mean a definite and wide penetration of the Austro-German line and give an excellent chance for the early capture of Lemberg. What has been accomplished recently by the Russians shows that not separated and isolated blows have been struck but that a fully organized offensive with objectives clearly in view is being carried out. The results gained have been capable of accomplishment only by well disciplined and enthusiastic troops most admirably led and well supplied with munitions of war. Very rapid advances have been made, so a temporary lull for rest and consolidation of advantages gained may be necessary. The next few weeks will give the test to show whether Russia is equipped in reserves and supplies for a long continued offensive; they will also show whether Germany and Austria have the necessary reserves in men and munitions to resist successfully the terrific onslaughts of their adversaries.

It is impossible to forecast what will be the outcome of the Russian drive, but one thing is certain—the Entente Allies have badly beaten Germany in the recent political upheaval in Russia, so far as diplomacy is concerned. Germany has evidently lost the influence that had been so carefully cultivated by intrigue and intimidation in that country. Russia is on the move despite occasional political upheavals, and our own country and the Allies are helping her; present events are only the forerunners of other more important developments that will no doubt be costly to the Austrian and German dynasties.

Some time ago President Wilson remarked that "the Germans can not advance and dare not retreat." This can be the only rational explanation for the continued fruitless attacks by them on the French positions along the Craonne Plateau and east of Rheims through the Champagne and around Verdun. The French offensive in the spring, like that of the British farther north, was a decided success, for the Germans have been forced into positions where they cannot safely stay and yet from which they dare not retreat; because, in the present political crisis in Germany, the home government would be brought face to face with very serious conditions. The Germans are not making any extended forward drives for any of the main French lines; their efforts seem to be principally directed toward retaking lost positions and valuable ground captured by the French. All their efforts have been accompanied by heavy losses and with no corresponding gain. The most desperate fighting has been along the Chemin des Dames from the Vauclerc Plateau to Laffaux and Laffaux Mill, this centering largely from the vicinity of Cerny to Jouy. Here for a long time there has been a constant see-saw in the tide of battle with varying success in localities—fortune in general favoring the French efforts. Repeated attacks in the Champagne and around Verdun have met almost always with decided checks and great losses. Around the latter city the German grip on important positions has been gradually loosened and a way is apparently being cleared for a stroke that may lead to a general German withdrawal.

On the extreme northwestern end of the front on the seashore of Belgium, and following attempts of the English to turn the German right flank, the Germans made a few days ago a furious and desperate endeavor to get around the Allied lines on the coast. After a twenty-four hour artillery fire and thorough German preparation, the attack was begun at Nieuport and Lombaertzyde but especially along the Dunes themselves. The English troops on the east bank of Yser canal were evidently taken by surprise and were nearly all killed, wounded, or taken prisoners. The movement itself was promptly checked, the Germans being unable to cross the canal at any point. The results of the struggle show, however, the folly of fighting a defensive battle with a stream of any size or depth at one's back. The few English who escaped from the fight did so by swimming the canal.

Whether this move of the Germans was only a minor operation or another real drive for Dunkirk or Calais cannot well be determined. Recent events in Germany have called for a speeding up of the war before any considerable number of troops from the United States arrive in Europe and this may have been an answer to the demands. If so, while the local results were a success, the ultimate results were a failure as the forward movement was quickly checked by the British. It would seem that Germany is now having recourse to desperate measures to bolster up a losing war.

Nothing of material interest appears to have taken place in Palestine recently; but the recent appointment of the English General Allenby to supreme command there indicates that important moves may be soon expected. In connection with operations there it now develops that the Grand Sheriff of Mecca has been continuing with success his activities in Arabia. He has been in revolt against the Turks and has apparently been extending his authority to the north. The defeat of the Turks and damage to the Hedjaz railway are mentioned. If reports are to be relied upon, Tafileh, 100 miles north of Akaba and 15 miles southeast of the Dead Sea, together with Maan to the south—both on the railway to Damascus from Medina—have been captured. If true, this will protect the right flank of

(Concluded on page 67)

The Potash Call

By Ellwood Hendrick

WE need potash so badly and need so much of it that every new report about it starts the hope that maybe the nut is cracked, but the need of it continues just as great as before. It is doubtful if over 50,000 tons of it are being produced annually outside of Germany, and right here in the United States it would not be difficult to find buyers for half a million tons, right off the bat. At the risk of wearying readers who have read time and time again of the Potash Call, I shall repeat that there is more potash in the crust of the earth than there is of soda, which is its close cousin, and that the potash is mostly tied up in rocks in an insoluble condition, whereas the soda is obtained from salt brine and there is salt brine for all the world available in any one of half a dozen states of this country. In Canada the situation is very like our own. Potash is needed for fertilizer; needed badly; but the situation is not such as was described by a German professor who foretold that our crops would all be failures for lack of it.

In Germany and there only they can dig it out of the earth. How it came there is a geological guess, and the writer is no geologist. The large deposits are in Hanover, Westphalia and Alsace; and Alsace is still within the iron ring. We are getting some from alunite from Utah, some from Pacific Coast kelp, some from Searles Lake, in California, some from the dust of cement mills and, fortunately, there is still potash in the earth. But we want more to make things grow lustier and faster. A slight source of supply is from the wastes of the beet sugar industry, which only provides that some of the potash which was extracted from the soil by the beets may go back again. Aside from fertilizer it is wanted for certain kinds of explosives, for matches, for shaving soap, in the glass industry and right and left in chemical procedure. Very often, as in glass, soda will do instead, but it is generally inferior; soda glass lacks the ring and the brilliancy that potash gives. In agriculture the substitution will not do at all. Plants are very much more particular than we are in this respect. A dose of ordinary (sodium) salt in the place of the desired potash will make fields bare, instead of bear.

All the time there are mountains of feldspar with billions of tons of potash, waiting to be taken out. It isn't so hard to get; the trouble is in the expense. It will come right out as pretty as you please, at the temperature of the electric arc, which is a very different process from digging it out of the ground as they do in Germany, and vastly more expensive. And manufacturing plants to do this sort of thing cost fortunes. The patent office in Washington, is almost choked with applications and rights granted for such processes and without doubt many of them have merit, but the feldspar potash industry does not seem to have reached the banking stage yet. Some remarkably promising ideas appear to be close to maturity, but Potash Preferred and Common are not yet listed on the Stock Exchange. It may be that the subject has been talked sick; that even capitalists with successful chemical experience have got so into the habit of looking into propositions and finding the technical problems unsolved that they do not jump at opportunities any more; and it may be that the right idea hasn't been hatched out yet.

Two methods have been presented lately which show promise, and of these one is already in operation in Canada, although probably still on a limited scale. It is the invention of Mr. Allan Grauel, of Kitchiner, Ontario, who worked it out originally to get potash for a powder plant in which he was interested. His process, which is patented, consists in heating in a blast furnace, 110-ton charges of feldspar, coal, calcium chloride and limestone. The ingredients are all cheap, excepting coal just now, and calcium chloride is a by-product of the soda industry which has been looking for jobs for a long time. At a high temperature the potash distills over as potassium chloride into a condenser, where it meets a current of steam, which dissolves it. The salt is said to crystalize out in a high state of purity. He recovers 90 per cent of the potash in the feldspar which contains from 8 to 14 per cent of it as potassium oxide. Soda vapors come over with the potash, but it is claimed that these are separated in a satisfactory manner. In operating the blast furnace the slag is run into molds and converted into sewer pipe, tile and paving brick, which has a peculiar porcelain-like surface. A company has been formed which has the enterprise in hand. The secretary, Mr. D. J. Benham, has advised the *Canadian Chemical Journal*, in which details of the process were published, that they expect to break the German monopoly for good and all.

Let's hope somebody will break it, anyway. I am informed that a Buffalo enterprise expects to be in the field soon after serious delays in installing equipment, producing potash and cement by first distilling over the potash. The thing to be borne in mind is that feldspar, as a potash ore, is always lean, and that it is necessary, under ordinary conditions, to find use for the great mass of other material that has to be treated.

Another process, details of which were lately given at the meeting of the American Institute of Chemical Engineers, seems still to be in the laboratory stage, but is promising. It is the invention of Professor J. P. W. Fraser and Dr. E. Miller of Johns Hopkins University, of Baltimore. In this, feldspar is ground and mixed with a mild solution of caustic potash, evaporated to dryness and heated to 200 to 300 degrees centigrade. (392 to 572 Fahrenheit). The subsequent treatments are leaching and neutralising with whatever mineral acid is desired for the potash salt. The remaining product is aluminium sulfate. A feldspar containing 10 per cent of potash will yield ¼ ton of 80 per cent chloride of potash to one ton of aluminium sulphate. The interesting feature here is that no great heat is required and the whole process seems to proceed along economical, chemical lines. What to do with four times as much alum cake as they get of potash may be a problem, but it is useful in clarifying water and in treating sewage, and there is always plenty of sewage.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Premature Explosion of Shells

To the Editor of the SCIENTIFIC AMERICAN:

While the cry for military inventions is going the rounds of the press, and inventors are feverishly calling for information concerning submarines, torpedoes, and other war-like weapons to aid them in their work, perhaps it would not be amiss to ask, "Are our military authorities really so on the alert for new contrivances?" The question is not an impertinent one if we call to mind the many notorious instances in which our experts have let revolutionary inventions slip through their hands. The recent case of Captain Lewis and his machine gun, which like so many other military inventions had to cross the ocean to win recognition for its merit, calls this ultra-conservatism of our military men again forcibly before us. Would it be too much to suspect that many other inventions, just as deserving as those which have hitherto been passed over, are lying neglected on the governmental shelf? It is not at all unlikely, and the recent unfortunate accident aboard the "Mongolia," in which two Red Cross nurses met death, brings forward a case that may be of just that kind.

We learn that that accident was due to the boomerang rebound of the brass casing cap on one of the shells. That in itself is not so serious, and might be explainable as a "freak." But it was further disclosed in the inquiry that of forty-five shots fired by the liner "St. Louis" in practice, nine had exploded in the guns and four had prematurely exploded in flight; in other words, nearly 30 per cent of all the shells fired went off prematurely. Further, Admiral Earle stated that the ammunition was as perfect as could be secured. Now, if this is the best ammunition procurable, and if it has behaved so lamentably, should not its faults be corrected?

Be it said to the credit of inventors that they long ago recognized the defects in these shells, and have solved the problem of righting these defects. To the ordnance department must be laid the blame for not adopting the improved shells. This was brought to my mind by the recollection of an article printed in the SCIENTIFIC AMERICAN, which I find to be in the issue of November 27th, 1915. Here is described a shell invented by a chief gunner in the United States Navy, a Mr. Gilmartin, who by training and experience obviously should be acquainted with his business, and whose improvements, the result of that experience, should therefore command attention by our ordnance officials. The novel construction of that shell is such as would do away entirely with all premature explosions, make the base-cap unnecessary, and afford other advantages not present in our standard ammunition. Why has not our ordnance department provided such ammunition as this for the important duty of protecting merchantmen, where a single premature explosion might mean the loss of a ship?

NOEL DEISCH.

Washington, D. C.

The Rights of the Enemy Patentee

To the Editor of the SCIENTIFIC AMERICAN:

I wish to call your attention to a dishonest and dangerous precedent, first set by England and poodle-dogged in the present fashion by the United States.

England has confiscated, or at least abrogated, German patents, and we are about to do the same. What is to prevent Germany retaliating? And, if she be victor in the struggle, entirely disclaiming any American patent rights, after the war, and manufacturing and selling as much and where she pleases?

Nothing but force of arms could stop her. I do not believe that American inventors as a class look on this business with a kindly eye. Necessity is the mother of invention—not fraud.

It is a difficult thing to give this war an honest and valiant appearance.

H. W. PHILLIPS.

New York City.

[The above letter contains several misstatements of fact and is based upon an entire misapprehension. England has never confiscated nor has it abrogated German patents, nor are we about to do the same. In the case of patents owned by Germans where it was essential that the industry established under the patent should be continued, the Government has extended the rights of manufacture to individuals but upon a royalty basis, the royalty settlement to be arranged after the completion of peace. The rights of the owners of the patents, however, are recognized and remain in force subject to these restrictions. It has been proposed that this policy, or some similar policy, should be adopted by the United States. There is no reason why an industry should be discontinued or that the goods produced under the patent should not be procurable owing to the fact that the patent right is owned by an alien enemy. Some basis must be found to avoid such an undesirable and unjust condition. It is pretty generally understood that in the case of inventions that might be of value for war purposes, the Imperial German Government is holding up the issue of such patents indefinitely, and there is every reason to believe that these patents are either being operated or are being held in escrow during the period of the war, or at all events at the will of the Government. In the case of medical specifics which are now offered to the public at extortionate prices, some way should be provided by the Government by which manufacture under proper conditions might be established, always bearing in mind the fact that the inventor's rights to a reasonable profit should be safeguarded.
—THE EDITOR.]

Beating Germany via the Air

To the Editor of the SCIENTIFIC AMERICAN:

I have read with interest various methods proposed by readers of your interesting journal for breaking the so-called German submarine blockade. My idea may not be practicable just at present, but in case an effective device is not invented to protect our and our Allies' merchant-men within the near future (which I sincerely hope will not be the case), we will have to search for another means of transporting the necessary food, equipment, etc., for our and the Allies' armies.

I suggest we look into the matter of utilising super-aircraft, similar to Zeppelins or the large aeroplanes reported soon to be in use on the Western front on which twenty to thirty passengers may ride, for transporting the necessary supplies across the Atlantic. Of course there will have to be new inventions and improvements installed but the scheme is possible. Haven't we read of long distant Zeppelin raids over England, air-craft coming from Chicago to New York, etc.? As for the necessity of descending due to breakdowns and repairs, a modified super-hydroplane or Zeppelin which might descend to the ocean's level, might be used, and we could have warships stationed every 100 or several hundred miles apart to serve as repair and mother ships for our transatlantic air-fleet. The size of the cargo would depend on the size of the air-craft, its motors and machinery, and would of course, not be as great as ordinary freighters can carry, but just as large as merchant submarines would be capable of transporting.

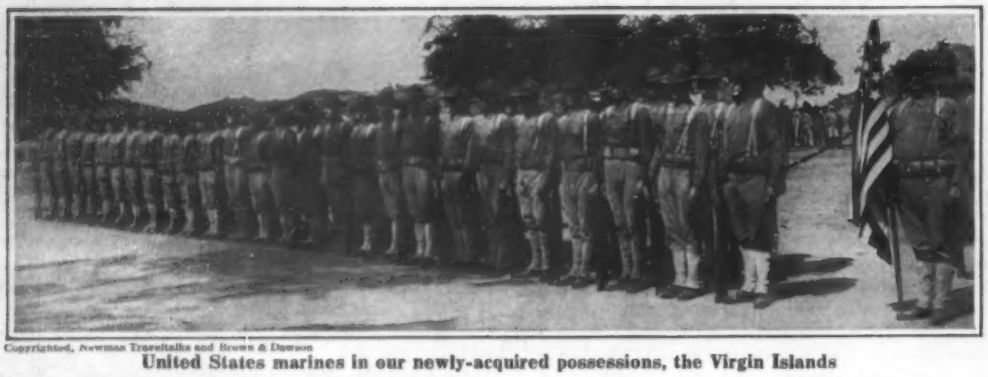
The advantages over merchant-submarines would be many, several of the most important being:

1. Ability to make transatlantic trips in a small fraction of the time the submarine would require.
2. No necessity of removing skilled help from our fleet, as the submarine would require.
3. Facility of obtaining skilled airmen to pilot our air fleet.
4. Practically no chance of being hit by gunfire from enemy submarines.

America has the brains and ability, the raw materials and the men successfully to master problems which would arise if the foregoing or some similar scheme were carried out. So even if the Germans do cripple our merchant sea-service, they can never beat us over the water.

JEROME D. STEIN.

Newark, N. J.



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United States marines in our newly-acquired possessions, the Virgin Islands

Manning a trench during the San Domingo uprising

The United States

A Military Body Qualified for Duty

THE people of the United States are very proud of that most efficient military body known as the Marine Corps—and with good reason; for not only is this the oldest military body in the Navy, but its organization antidates that of the Navy itself, as we may learn from the following brief historical notes:

The origin of the Marines in America carries us back to the year 1740 when three regiments were organized in New York for service under the British flag. This was done largely for the reason that native Americans were presumed to be better fitted for service in our climate than Europeans. Thirty-five years later, on June 8th 1775, the Continental Congress resolved: "that the compact between the crown and Massachusetts Bay is dissolved," and on November 10th, of that year, before a single vessel of the Navy was sent to sea, the Marine Corps was organized by a resolution, which stated among other things that particular care was to be taken that "no person be appointed to officers or enlisted in said battalions but such as are good seamen or so acquainted with maritime affairs as to be able to serve to advantage by sea when required." These troops were to be known as the First and Second Battalions of American Marines. In the following year, on December 13th, 1776, Congress ordered that thirteen ships of war be built, and nine days later Esek Hopkins was declared Commander-in-Chief of that new Navy which was to win imperishable fame, and endear itself so strongly to the people of the American Republic. On these dates and facts as given, the Marine Corps may justly claim to be "the oldest in the service."

That the Marine Corps is equally at home upon the land and the sea was shown by the dashing exploit of the Marines in the year following the birth of the Navy, that is to say in February, 1777, when a battalion of 300 Marines and Landsmen landed from Hopkins' fleet on the Island of New Providence in the Bahamas, captured the English forts, and secured a large quantity of those cannon and military stores of which the Continental Army stood in such sore need.

As the first battle of the American Navy was fought and won by the Marines, so, down through the years of the Revolutionary War, we find the Marines at the forefront when difficult work was to be done. In fact there were but few expeditions in which they did not figure in more or less strength. Thus Lieut. Wallingford of the Marines died at the head of his men under John Paul Jones in the battle between the "Ranger" and the "Drake"; and in the classic fight between the "Bon Homme Richard" under Paul Jones and the "Serapis," the Marines lost 49 out of 137 men. Later, under Gen. Eaton, the American Consul at Tunis, the Marine Corps formed a large part of a force which marched some 600 miles across the deserts of North Africa, and, after capturing the native forts, for the first time in the history of the country hoisted the flag of the Republic on a fortress of the old world. In the War of 1812, the first officer to fall in the famous victory of the "Constitution" over the "Guerriere" was Lieut. Bush, Commander of the Marine Corps. We find the Marines in the Battles of Lake Champlain and Lake Erie; in the action between the "Constitution" and the "Cyane" and the "Levant"; and engaged with the Army under Scott in Canada, under General Jackson at New Orleans, and in many another fight on shore.

The records of the Marine Corps show that it took part in practically all the operations of the Mexican War; and in the great assault at Chapultepec the storming party was led by Majors Twiggs and Reynolds of the Marine Corps. Later we find these same Marines which fought in Mexico marching through the capital of Japan under Commodore Perry when he opened up that ancient empire to modern civilization.

Coming down to the Civil War we learn that 100 Marines were sent to Harper's Ferry for the capture of John Brown and the suppression of the rebels. Marines were dispatched as a reinforcement to Fort Sumter and many another southern fort; they were in the first battle of Bull Run, and in the fight between the "Merrimac" and her opponents.

Twenty years later, a detachment of Marines was landed at Alexandria, Egypt, to preserve order and prevent outrage; and three years later we find two battalions at Panama keeping open transportation across the Isthmus. In 1893 Marines were present during the revolution at Honolulu, protecting the lives and property of American residents.

Most of us will remember that it was the Marines who seized Guantanamo, Cuba, during the Spanish War, and held it with the assistance of the ships, thus securing a base for the Navy. They were in the sea fight of Santiago, and on the other side of the world they were landed from Dewey's fleet to hold the fort and naval station at Cavite after the Battle of Manila Bay. Later, they were present on the march to Peking. But the most unique experience in the history of their campaigning surely was when, in November, 1903, a company of Marines commanded by Captain Thorpe and mounted on camels, accompanied the American emissary across the African Desert, on his trip to the capital of Abyssinia for a conference with King Menelik.

And so the record continues—a record of service in all climates and

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Digging the trench for the m

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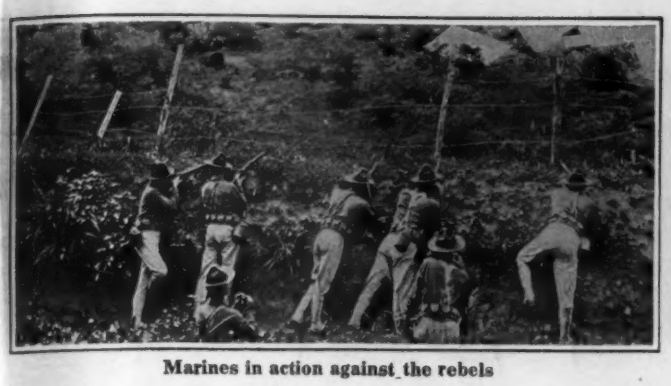
One of the streets of the cant

Panoramic view of the new cantonment, nearing completion at Guan



Marines in action against the rebels

Marines as cavalry and foot troops in action in San Domingo

Marine Corps

with Either the Army or the Navy

under widely varying conditions, in every one of which this splendid body of men has lived up to its well-earned reputation.

The literature of the United States Marine Corps, from which the above historical facts have been culled, states that the Marines are organized, clothed and equipped very much the same as the soldiers of the land forces, and for these reasons they are qualified for duty with either the Army or the Navy, and are therefore of double value to the nation which employs them. Their headquarters, barracks, and depots are always on shore, and Marine detachments are to be found upon all the ships of the Navy. These vary in strength from a dozen men under a sergeant to from 60 to 80 men on our dreadnoughts under one or two commissioned officers. On board a dreadnought in time of battle the Marines man a portion of the secondary or torpedo battery, and it can readily be understood that there is the keenest rivalry during target practice between them and the enlisted seamen.

The popularity of the Marine Corps has been demonstrated by the fact that when, on our entrance into the war the strength of the enlisted forces was raised from 10,000 to 30,000 men, the whole number was very quickly secured by voluntary enlistment.

For the training of the newly enlisted men several training camps have been erected and we have selected the new camp at Quantico, Va., for illustration and description. The camp has been built in record time and in every respect it represents the most up-to-date ideas as to location and sanitary, medical and recreation requirements. In view of the fact that contracts have been let for the sixteen great cantonments which will be necessary to house the 625,000 men selected from the Army draft, this camp possesses special interest; for, in the main, all of the army cantonments will be built practically along the same lines and will follow the same general layout as the camp at Quantico.

The location is on the right bank of the Potomac River, at a point about thirty-five miles below Washington. The river banks at this point are from 20 to 30 feet in height and the beach, which is sandy and gently sloping, affords excellent bathing facilities for the men—a most important consideration. The river provides good facilities for boat drills and for practice in mine laying and similar defensive measures. The land adjacent to the river is fairly level, and more remote from the river it rises gradually on an easy slope to an elevation of about 100 feet. Upon this rising ground is being built the majority of the accommodations, which are sufficient to take care of two regiments of Infantry each of approximately 2,700 enlisted men, and one regiment of Artillery of 700 men. The majority of the buildings, of course, consists of the barracks or living quarters for the men. The layout of the camp is like that of any city built on the rectangular plan, consisting of blocks 355 feet in length, with streets that are alternately 20 and 30 feet in width.

When the contractors started work they found the greater part of the site covered with the characteristic growth of pine trees, shown in the panoramic view of the camp, which had to be cut down and cleared before building could commence.

As an indication of the excellent quality of the young men that have enlisted in this Corps, it should be mentioned that, when the survey of the ground was made to establish the contours, the enlisted men were able to furnish a surveying party with the necessary technical knowledge for the work.

Two of the most important questions to be considered in building a camp of this kind are a sufficient drinking supply and a thorough system of sewerage. The water was secured by driving two artesian wells, and the sewage of the camp is carried to the Potomac by a 12-inch main, the excavation for which is shown in one of our illustrations.

In this connection mention should be made of the ingenious and certainly novel method of extending the outfall pipe into the Potomac. The lengths of pipe were firmly strapped down to heavy planking, connected up, and pushed out over the mud bottom into the Potomac. The advance, as each length was bolted on at the shore end, was made by using the river bank as an abutment and interposing powerful screw jacks between the abutment and the inshore end of the pipe line. Alinement is preserved by means of heavy guide stakes driven in the river bottom.

A splendid site for the hospital has been selected on the river bluff where patients will get the full benefit of the river breezes. The lay of the land is such that good accommodation has been found for a drill ground, for an aviation field and for small arms and artillery ranges. In addition to the necessary barracks for the men the buildings include the necessary administrative offices, store rooms, horse and truck shelters, power plant, etc. The fine panoramic view and other pictures of the camp which we show were taken on June 20th. The finished grading of the streets, etc., has not yet been done; but when it is completed, the men, following the immemorial custom of camps of this kind, will probably give a homelike touch to the place by a measure of flower and landscape gardening.

We are indebted to Col. A. W. Catlin, and to Major Seth Williams, Constructing Quartermaster, for courtesies extended during our visit to Quantico to secure material for this article.

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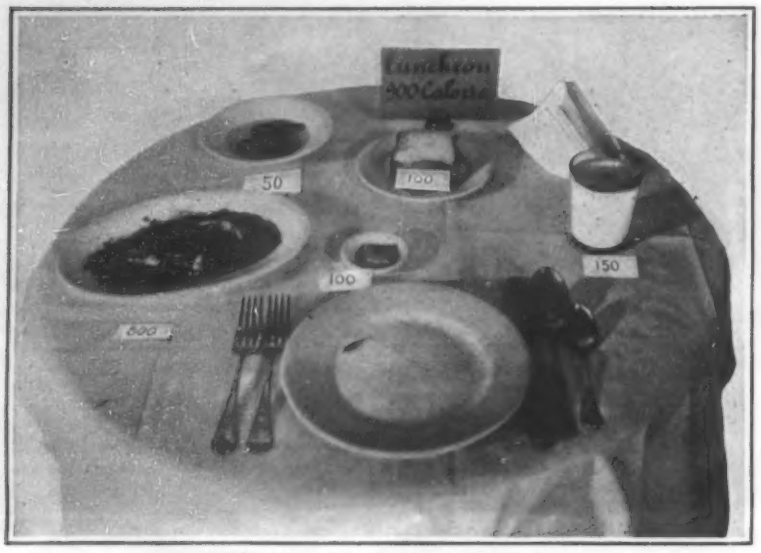
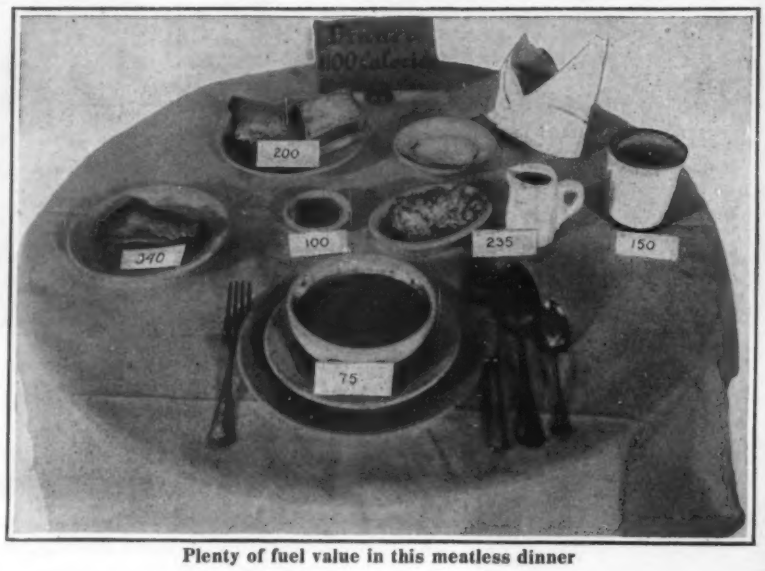
of the onment during construction

letion Quantico, Virginia, for training recruits of the U. S. Marine Corps



A dainty lunch of nine hundred calories



Plenty of fuel value in this meatless dinner

Fuel Values of Foods

The Bill of Fare of the Future, Pricing Each Item in Calories as Well as Cash

By Dr. Charles F. Bolduan, of the New York City Department of Health

TWO weeks ago there appeared under the caption "Pictured Physiology," certain phases of the human body as analogous to a series of factories governed from "Headquarters." This pretty conceit brings home to the reader the fact that the human body is a beautiful, though complicated engine. A Chinaman who had never seen a steam locomotive once asked what made the iron monstrosity go. The engineer replied in pigeon English: "Heap strong man inside drink plenty water, eat coal; no water, no coal, no workee." This is equally true of the human machine. Other fuels are substituted for coal or wood, but they are none the less fuels, and some of them are better than others. It is the object of the present article to differentiate in popular form between some of the ordinary foods, affording to a certain extent a criterion for so constructing the ration that maximum food values can be obtained with the minimum of expense—adding, of course, some items like watermelon, where the food value is practically nil. The planning of a meal nowadays, with war conditions already tacked on to an inflated cost of living, is not so simple as it once was, and a great campaign of education is in progress along this line. The question of marketing is an all important one, and frequently some of the most nourishing and easily digested foods can be obtained at moderate figures if exact knowledge of the food values be substituted for appeal to the eye as a marketing test.

In brief, all food materials may be roughly classified into two classes—nutritive and non-nutritive. The nutritive constituents may be roughly divided into: protein, which includes all nitrogenous substances except the fats; carbohydrates, such as sugar, starch, cellulose, etc.; fats, mineral matter or ash, and water. These five substances are necessary to the human economy, for two purposes; first to repair the waste tissue, and second, to furnish energy for heat or work. In our subtle chemical laboratories, we transform entirely many chemical substances, and this must be taken into consideration, consciously or unconsciously.

The methods of calculating the energy of foods are strictly scientific, and the unit of measure is the calory. A calory is the amount of heat which will raise one liter of water (slightly more than a quart) one degree Centigrade. Scientists have calculated almost every type of food and have shown them to produce a certain number of calories per pound, which, by a very simple process, can be converted into calories per portion, as ordinarily served.

The fuel foods are burned in the body exactly as though they were burned in a fire, and the resulting products are the same, carbon dioxide and water. It is possible to live entirely on a vegetable diet, although those who affect this diet usually make large use of two very convenient and highly concentrated foods of animal origin, namely, milk and eggs. Nature adapts the body very closely to the kind of food habitually used. In this country meat forms a large part of our diet, and this results in our great energy compared with nations which exist principally upon such foods as rice, although it does not follow that such peoples have no capacity for work.

Scientists have discovered that those who lead sedentary lives require only about 2,500 calories, *i. e.*, heat units per day. Women usually require a smaller number of calories than men, but the amount varies with the work performed. A washerwoman requires 2,800 calories, while a seamstress could exist (and unfortunately often does) on 1,800 calories. A man engaged in very heavy work like that of a lumberman may require 5,000 calories. Food must have bulk; thus, a pound of watermelon has a food value of only 60 calories, but the water and cellulose are of value.

DAIRY DISHES, with Milk or Cream from our Selected Dairies

Bottle, half milk, half cream, **10** *extra; all cream,* **15** *extra*

Crackers, Soda, Milk or Graham, with Milk (377)	10
Bread, White or Graham, with Milk (317)	10
Flaked Cereals, with Milk (228)	10
Shredded Wheat, with Milk (478)	10
Rice, with Milk or Butter, 10; with Cream, 15	

STEAKS, CHOPS, HAM, BACON, Etc.

*Beefsteak (385)	40	*Fried (494) or Broiled Ham (592)	30
*Sirloin Steak (1280)	50	*Bacon Broiled (741)	30
*Tenderloin Steak (1159)	55	Corned Beef Hash (515)	
*Lamb Chops (811)	40	Steamed or Browned in the Pan (308)	20
*Ham and Eggs (791)	35	*Liver and Bacon (741)	25
*Bacon and Eggs (776)	35		

POSITIVELY FRESH EGGS

Two Eggs, Boiled, Fried, Scrambled or Poached (204) (456) (428) (262)	20
Two Poached Eggs on Toast	20
Two Creamed Eggs on Toast (602)	25
Two Scrambled Eggs and Chipped Beef (609)	25
Plain Omelet (494)	20
Onion Omelet (510)	25
*Ham Omelet (662)	25
*Chicken Omelet (950)	30

Butter Cakes, Toast or Bread Included with the above
*Rice or Spaghetti Served with Orders

This bill-of-fare prices the foods in calories as well as in money

The interest in the subject of food values expressed in calories is very great at the present time. One concern of restaurant proprietors, at the writer's suggestion, have gone so far as to print in parenthesis the number of calories, thus: "(632-429) cold ham or corned beef, potato salad, 20 cents," indicates that the portion as supplied would have 632 calories if ham was ordered, or 429 if corned beef should be selected. This is a most valuable innovation and should be universally adopted—if necessary, by order of the Boards of Health.

In the entrance hall to the American Museum of Natural History we find three tables with appetizing meals set out. At first sight the visitor might think the food is cleverly made of wax or papier mache, but on a good hot day when the butter melts, it dawns on one that it is real, not "property" food. The cost of the entire ration for the day is only about 25 cents.

The menu with the number of calories is as follows: *Breakfast:* stewed prunes, 100; sugar, 50; milk, 100; corn meal mush, 150; butter, 100; coffee with sugar and cream, 100; bread, 50, total, 650. *Lunch:* bacon and beans, 500; milk, 150; bread, 100; butter, 100; peaches 50, total 900. *Dinner:* tomato soup, 75; bread 200; milk, 150; rice and milk 235; butter, 100; pie, 340, total 1,100.

Our large engraving shows in graphical form, a market with the articles priced in "calories per pound" and not dollars and cents. Some surprises are in store. One is tempted to go out at once and buy butter, cheese, bacon, nuts, lard and crullers. Probably such purchases would not bring the desired feeling of contentment unless a liberal quantity of cereals and vegetables were added. Celery is almost worthless as a fuel producer, and so is asparagus, while corn and lima beans bulk heavily. Spinach, cabbage and cauliflower also take a back seat, along with cucumbers, while potatoes, onions, grapes and nuts come into their own. The well-thought of, but humble banana, is far above the aristocratic orange and tomato; catsup shows a large increase over the tomato. Milk is a valuable fuel food, as are eggs and gelatine, and for this reason desserts made of milk and eggs combined with gelatine are so healthful.

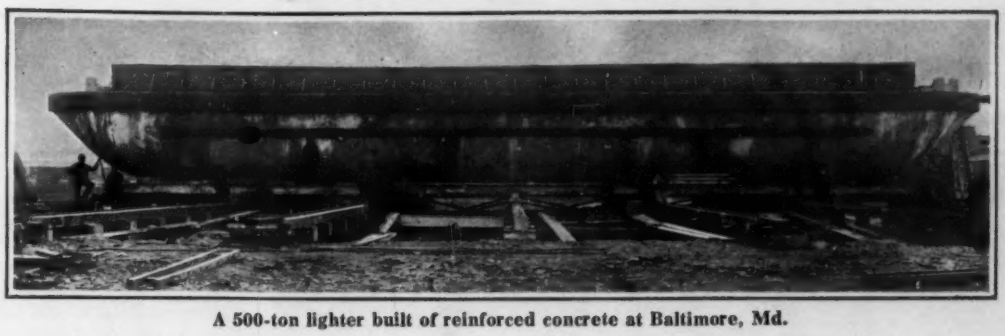
Fish is an excellent food, but the lobster is disappointing when compared with the shad, though it can lord it over the oyster and the clam. Mince pie has from 1,270 to 1,335 calories as against 830 for custard pie. Crullers deserve their popularity owing to their large absorption of grease. Chocolate is true to its reputation as a hunger chaser, candy and sugar in almost any shape are good. Bread maintains its place as the staff of life, but weight for weight is not so valuable as macaroni or soda crackers. The boxes of cereals tell their own story. Poultry is excellent, beginning with chicken 890, duck 1290, turkey 1,385 and goose 1,940. Ham and bacon are very high in fuel values, and lard is the highest of all. Beef depends upon the cut, but 1,370 for ribs is average; veal is 1,790, leg of lamb is 1,300, and mutton is 1,085.

It is possible with the aid of this picture to make up a substantial ration which will be not only economical, but which is scientifically designed. The sample menu illustrated for breakfast, lunch and dinner gives a fairly good key to the arrangement and in a subsequent issue we may take up the balancing of the ration.

An appetizing and well balanced breakfast

Concrete Ships

IN years gone by we have illustrated various types of concrete vessels, chiefly barges for river and canal work. At first these were regarded as rather freakish constructions; but as time passed by and the boats were put to the test of day by day service, they proved their worth and brought the concrete—or rather re-inforced concrete into the list of available shipbuilding materials. Nor is this conception an altogether novel one; for we learn that as far back as the middle of the last century a boat of reinforced concrete was built by a Frenchman, which is still in service.



A 500-ton lighter built of reinforced concrete at Baltimore, Md.

Hitherto the use of reinforced concrete has been confined to barges and vessels of similar type. Thus concrete barges have been built and used on the Panama Canal to such good effect that recently the engineers have constructed pontoons, 125 feet in length, to serve as landing stages for small craft. We direct attention to the accompanying illustration of a lighter of 500 tons capacity, which has recently been completed by a firm in Baltimore.

Our Consul at Christiania has lately described a plant at Moss, Norway, where concrete ships of as high as 3,000 tons displacement are being built. The Swedish Minister of Marine has recently ordered a lighter of 1,000 tons. Building ways are being erected for a ship of 4,000 tons at the same plant.

There is no structural reason why thoroughly reinforced concrete should not prove to be a satisfactory material for the construction of large ships; provided the stresses are carefully worked out, and a perfect bond is secured between the concrete and the steel reinforcement. The cellular, double bottom, the strongly ribbed sides, the stiffened bulkheads—all lend themselves to being molded and cast in the proper forms. The result will be a ship of equal strength to one of steel, but of greater weight.

How Uncle Sam Marks His Fighting Aircraft

SOONER or later aircraft in large numbers bearing a new insignia are going to take their place on the fighting line in Europe, beside those bearing the bull's eye of Allied aeroplanes, in order to combat those bearing the Maltese Cross of the Germans. These will be the American aircraft, and their insignia is to consist of a circular blue field with a white star and a bright red center.

All American aircraft are being marked with the five-point star insignia. In order to save the time and labor which would be required to lay out and paint each insignia or seal separately, most aircraft factories employ a stencil as a guide as shown in one of the accompanying illustrations. After the insignia has been painted the work is finished off and the edges cleaned as shown in the second illustration.

An Aerial Fire-Truck

SINCE the first flight of Wilbur Wright, aircraft have been put to many uses, chiefly of a military character. Now, however, attention is beginning to turn to the commercial side; and among the possibilities we find that of fighting fire.

The fire department of San Diego, Cal., claims the distinction of being the first in the world to adopt the seaplane. Two years ago the fire chief inspected the fire zones of the city from an aeroplane, and he has frequently made similar flights since. Now his ideas for an aerial fire-fighting unit for duty along the waterfront have been actually put into effect.

San Diego's truck for fighting fire from the air

The San Diego aerial fire-fighting truck, which is now an integral part of the city's fire department, is a 110-horse-power flying boat, equipped with dual controls, and making a horizontal flight speed of 75 miles per hour. The top wing section is 43 feet long, the bottom 39. The wings are made in six-foot sections except the right and left upper sections, which overlap two feet for additional lift and stability. The hull is 24 feet long, with a three-foot beam, and is fitted with watertight compartments and lockers for carrying the fire-fighting equipment. An additional seat for a third passenger is also provided. For night flying two small but highly efficient searchlights are mounted on either side of the cockpit. Power for these is derived from electric batteries fastened to the bottom of the hull, well abaft the passenger compartment.

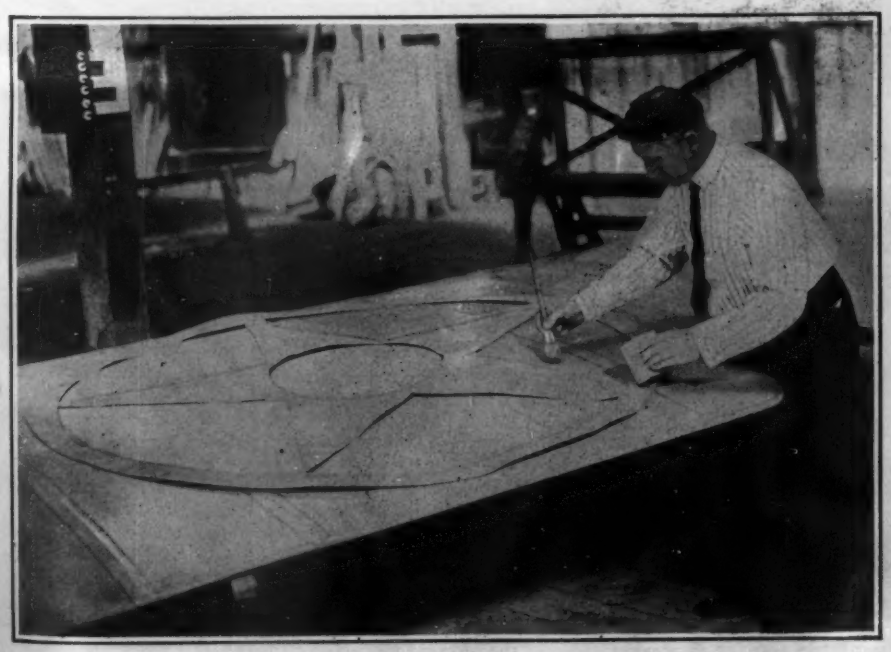
It is claimed by the sponsors of this new engine that owing to the rapidity with which it could reach the scene of the outbreak, it should be fully 50 per cent more efficient than a fire tug in combating small fires on steamers or in isolated sections of the harbor. In many cases what might, in the absence of the aerial truck, develop into a serious fire, will be put out before it is fairly started.

Is Molybdenum a Benefit in Tool Steel?

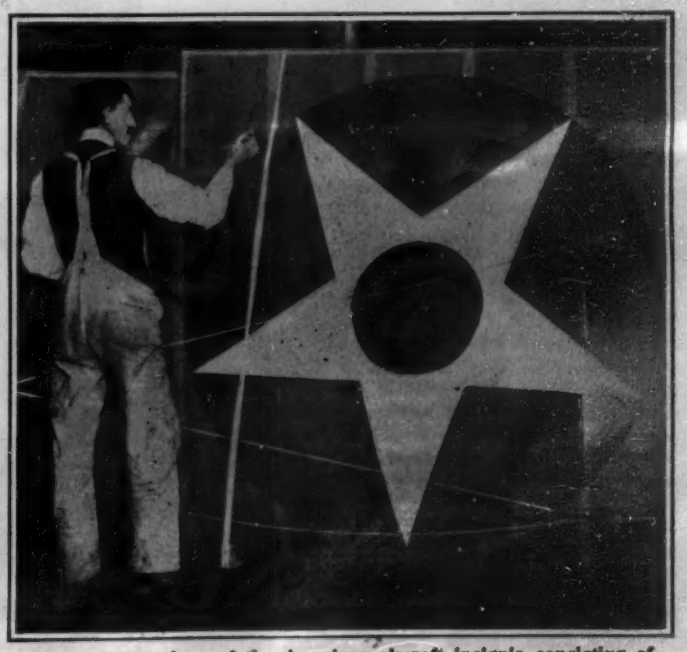
SOME claim that molybdenum is a benefit in tool steel while others deny this. It appears that one of the big difficulties experienced in using molybdenum for tool steel is that molybdenum tool steels are likely to crack in quenching, and do not retain their cutting edge after retreatment, owing to the disappearance of the molybdenum from the outer skin of the steel through volatilization. In some instances tests have shown irregular cutting speeds and tendency of the molybdenum to render the tools brittle and weak in their bodies. Again, molybdenum steel has developed seams and a tendency to firecrack during treatment.

These drawbacks may be overcome or avoided by special care and skill in the preparation of molybdenum steels of high carbon, according to a recent authoritative opinion. Great care is also needed in annealing after the material has been worked into bars and before it is cut into shapes and previous to the hardening. Some of the objectionable features enumerated above are due to the use of impure ingredients in the manufacture of the steel or to improper heat treatment.

In the United States and to a less extent elsewhere, the majority of the manufacturers have almost entirely discontinued the use of molybdenum as a major constituent in tool steel, and are now using it in a minor capacity in conjunction with tungsten, cobalt and other rare metals. From two to three per cent of molybdenum is employed in the manufacture of magnet steel, and an alloy containing two to five per cent molybdenum, ten per cent chromium, and little or no carbon is said to be acid proof or stainless. One inventor is quoted as saying that when molybdenum is added to a 15-per cent cobalt-chromium alloy, the alloy rapidly hardens as the molybdenum content increases, until, when such content reaches 40 per cent the material becomes exceedingly hard and brittle. It cuts keenly and deeply into glass, takes a beautiful polish, which it retains under all conditions, and its surface is not readily scratched. A wide application is predicted for an alloy containing 25 per cent molybdenum and 15 per cent chrome for the manufacture of fine hard cutlery, but as it cannot be forged the blades would have to be cast.



In order to save the time and labor required to lay out and paint each insignia separately, this stencil is employed



Cleaning the edges of the American aircraft insignia consisting of circular blue field, white star and a red center

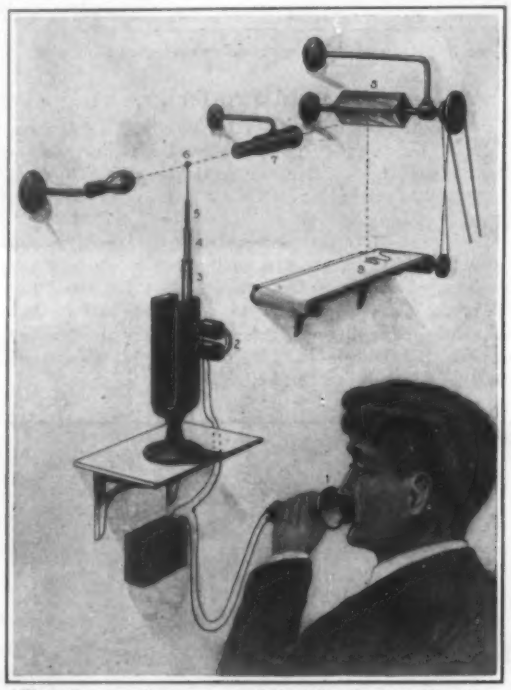
Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Making the Sound Wave Sign Its Name

WE illustrate an improved and very ingenious apparatus for measuring and recording mechanical, acoustic, or electro-magnetic oscillations or impulses. In explanation of the diagram it is to be stated that 1 represents the sound horn or receiver which transmits the arriving sound or impulse wave to a microphone operating an electro-magnet 2 by means of any convenient current source, and producing vibrations in the tuning fork and the attached glass rods 3, 4, 5, and through them in the glass ball 6. A beam of light from the bulb passes through this ball and through the microscope 7, to the rotating mirror 8 and thence to the sensitized paper 9, making the desired record of the vibration.

A feature of the apparatus consists in the glass rods of diminishing diameters. As each of these has its own natural period of vibration a greater movement of the glass ball can be obtained than with a single member. Also the parts can be so proportioned as to react upon each other and cause the vibrations to subside very quickly. By proper adjustment it is entirely possible to insure that complete rest shall follow within no more than one-fiftieth of a second after a very large deflection. Furthermore, one or more of the rods can be made to vibrate to the harmonies of a note, with corresponding modification of the recording curve. This, of course, would not be the case if the simple tuning fork alone were used, as this responds principally to the fundamental note, and little or not at all to the harmonies.



How the sound wave records itself in black and white

A Branding-Iron for Oranges

AN association of California fruit growers which sends its oranges to market in branded boxes, with branded tissue wrappers for the individual oranges, has suffered considerably of late from unscrupulous retailing methods all over the country. Not only have small displays of the branded oranges been used on stands and in windows to bolster the price of cheaper fruit, but in places the wrappers bearing the extensively advertised trade-mark and brand name have actually been put upon oranges of the very cheapest grades. Naturally such practices have a very bad effect upon the reputation of the branded fruit, aside from the direct loss of sales; so the growers who own the trade name in question have been seeking a means of prevention.

Obviously such a means would be the branding of the fruit itself, instead of merely the box and the wrappers; and accordingly a machine has been developed to do just this, burning the name into the skin of the orange and filling the scar thus made with indelible ink. This machine, which we illustrate, consists of a big wheel of eighteen spokes, each capped with an iron head bearing a brand. The oranges are carried to the wheel by an endless belt of shallow metal cups; and as the running belt passes beneath the revolving wheel, the successive brands come in contact with successive oranges and make the necessary mark upon them.

Each spoke consists for part of its length of a light spring that expands and contracts as pressure is applied or withdrawn, so the branding iron easily adjusts itself to oranges of different sizes and, regardless of the size, the skin is not broken by the brand. The iron is heated by electricity, the device working by means of a thermostat, so that the current is automatically applied when the iron falls below a certain temperature, just as it is cut off when the temperature goes above a certain point. As each brand comes upon the face of the orange and is pressed into it, a device upon the top of the wheel drops an indelible ink upon the letters of the brand and a rolling ribbon distributes this ink. The brand penetrates the skin, and the heat of the iron melts the wax which is so plainly to be observed in the peel of all California seedless oranges. The wax flows into the imprint under the die of the brand name, making a wax base into which the heat of the iron dries the ink, so that the name appears permanently fixed in the skin of the orange.

At twenty revolutions per minute, this branding wheel will stamp the name upon 360 oranges per minute, which works out as two carloads per working day of eight hours. Four machines will take care of the daily output of the average orange packing and shipping house.

Branding high-grade oranges to prevent substitution

No More Shoveling in the Dark

THE accompanying illustration shows a novel device which loads wagons in thirty seconds and dumps automatically. This loader was developed at Rochester, N. Y., for the rapid and economical loading of sand, gravel, crushed stone, coal, coke, cinders and other material into motor trucks, traction drawn wagons, dump wagons and other vehicles, from railroad cars, gravel pits, cinder piles, coal yards and other sources where the material to be hauled can be shoveled by hand or elevated by mechanical means into the loader. It is so designed that it tips easily and returns to position automatically by gravity. It can be placed so that it will clear any standard vehicle, when it is used to load wagons from railroad cars. It is in two parts and is light enough so that two men can handle it readily.

How the shovel is made to watch its step

It is stated that it is so economical that it only requires the handling of about 300 cubic yards of crushed stone or gravel out of railroad cars to pay for one loader by the saving which it will make in team time over the old style methods of holding the team while shoveling into the wagon. It also saves time shoveling over any other method or device, because the shovelers can always see where they are pitching their shovelful, and do not waste time or "soldier" by looking over the side of the car, to see if they are pitching into the wagon. This feature alone also prevents a large percentage of the waste on the ground and consequent re-shoveling and cleaning up. Moreover, a considerable amount of shoveling can be done when there is no wagon beside the car, thus saving much of the shovelers' time that was formerly wasted.

It is claimed that four men shoveling into this rapid loader will handle as much material as six men will handle otherwise. It can be easily used for the quick loading of motor trucks and traction drawn wagons from an ordinary railroad gondola or coal car. As it is made entirely of steel, it is practically indestructible while at the same time it is as light as is consistent with proper strength and durability. Being made in two parts, which are separable, it is easily and quickly put in place or taken down and moved to another car. There are no hinges, latches or doors on it to get bent and out of shape.

On a state highway job at Holcomb, N. Y., before using the rapid loaders the round trip per truck consumed one hour and thirty minutes, but with four rapid loaders reducing the time usually lost when loading, the 5-ton truck made the round trip in one hour—a time saving of 33½ per cent, and an increase in deliveries of 50 per cent, cutting out practically all the lost time, and increasing the earnings almost $22 daily.

The Current Supplement

IN these days when the entire world is putting forth the utmost exertions to furnish an adequate supply of food it is evident that the weather is a most important factor in the problem, and that an accurate foreknowledge of weather conditions would greatly facilitate agricultural operations. We are now able to foretell the weather with great accuracy for short periods, but how invaluable would it be if it was possible to know the weather conditions months in advance! This matter is discussed by one of the leading authorities in this country in an article on *Forecasting the Seasons*, which appears in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2169, for July 28th. *The Internal Secretions* considers the chemical factors in the regulation of the organism. *The Life History of a Wasp* is an interesting series of unusual photographs that show the development of these busy insects, and is accompanied by explanatory notes. *Engineering in the Great European War* tells how the work of the engineer has rendered former day military tactics and strategy subordinate factors. An interesting illustration shows a great waterspout that appeared in the Gulf of Genoa early in the year. The lectures on *The Electrical Properties of Gases*, by Sir J. J. Thomson, are continued in this issue. *Heredity and Sex* is an important contribution to the theory of Mendelism and some of its recent developments, and is accompanied by a large number of valuable illustrations. *Gravitational Attraction* discusses the connecting mechanism of a problem of physics of which little is now known. *The Unipolar Dynamo and Its Future* discusses a simple and efficient type of electric generator that possesses great possibilities. It is accompanied by explanatory diagrams and tables of value. *Mechanical Testing of Cast Iron* describes a device for determining the hardness of this material that is intended to furnish information of value in the mechanical arts. Two diagrams illustrate the device and its use. *Grain Size Measurements in Metals* considers a question of importance relating to the physical properties of materials. There are a number of shorter articles of general interest.

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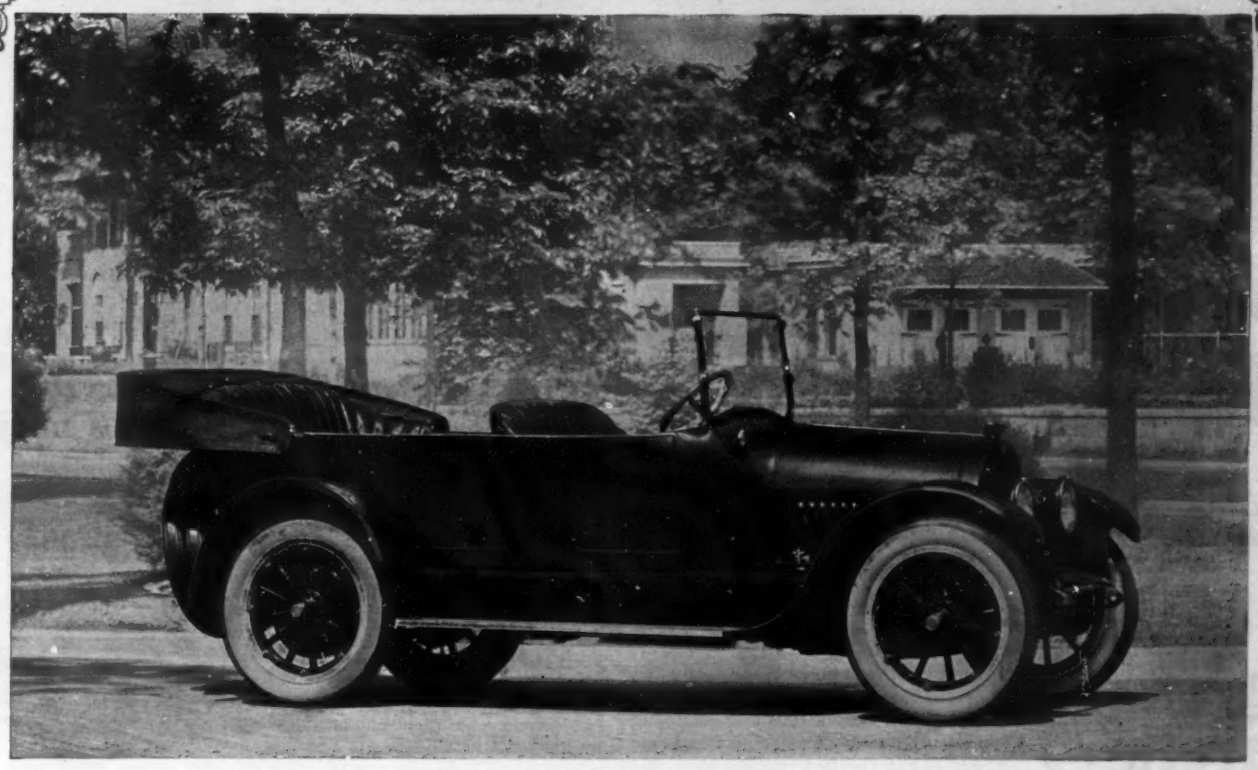

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The Heavy Shall Rise and the Light Shall Fall

(Concluded from page 57)

floating mineral particles are supported by the surface film of the liquid—some of our readers may be familiar with the fact that a needle can be floated on the top of a brimming glass of water, if laid on so gently as not to rupture this film—this method is vastly overshadowed by "froth flotation," where the minerals to be floated are collected within and upon the surfaces of air or gas bubbles, which may be either driven into the liquid from without, or generated within it. The froth method enjoys the great advantage over the film method in that a surface froth is of far greater volume than a surface film, and hence will carry a much greater burden per unit of liquid surface.

While a great mass of technical detail has been built up about froth flotation, its essential principles are simple enough. The ore must be ground so that it will pass through a 50-mesh screen; flotation of larger particles is attended by heavy loss of the coarser grains. The whole process, in fact, seems to depend upon phenomena of the infinitesimal, upon the fact that tiny particles of any substance often will behave quite differently from fragments of ordinary size. This finely ground ore is suspended in water to form a sort of pulp, and the mass is treated so that bubbles form and, of course, rise to the top. But a so-called frothing agent has been added to aid the formation of froth and to increase the tendency, already present, for the bubbles of the liquid film to attach themselves to the metal bearing particles of ore, as distinguished from the gangue. Why they should do this is not wholly clear; the fact remains that they do it, and that each bubble, as it rises toward the surface, carries with it its load of mineral. Bubbles of mechanical froth, created by beating the pulp, come up loaded to full capacity. Pneumatic froth bubbles, on the other hand, generated by the insertion in the pulp of a compressed air exhaust, carry but a few grains of the mineral each.

When the bubbles burst upon the surface the minerals carried by them are caught by the bubbles just below. The mechanical froth is tough and fairly permanent; so this machine is provided with a box for the collection of froth, in which there is comparative quiet. The mineral particles become closely packed, and the water drains out of the froth, leaving a sort of mineral mud, a dense scum that floats on the surface in spite of the fact that it is heavier than the fluid beneath. The pneumatic froth is kept more or less fluffy, and consequently somewhat wetter than the other, by constant passage of large quantities of air. In neither system is the procedure for recovering the froth sufficiently standardized to justify any remarks beyond the very obvious one that it must be removed in some manner from time to time.

The frothing agent is usually an oil or a substance of oily character, and this has led to the somewhat erroneous term, "oil flotation." The oil does not in any sense float the mineral particles, as might be inferred from this name. It simply aids in the formation of gas bubbles which act as described. The percentage of oil which can be most advantageously employed is still greatly controverted, and even has a bearing upon the validity of basic patents.

An excellent insight into the mechanism of flotation is given by the findings of the Bureau of Mines with regard to the proper consistency of the pulp. We are told that "if a given ore be crushed to a definite size and treated by flotation, the more dilute the pulp the cleaner is the concentrate. This is because less gangue is intrained in the froth made from the dilute pulp. It is also noticed that the extraction falls off, mainly because the coarser particles are not floated. It would seem that in more concentrated pulps the smaller particles of mineral assist in the floating of the larger particles. When flotation is attempted in dilute pulp these larger particles are not so close to their smaller neighbors and are not carried into the froth with them. If the ore is already finely ground the thicker pulps often give such a poor concentrate that dilution greatly increases the grade of concentrate. In fact, some slimes can not be treated in any other than a dilute pulp—five or more tons of water to one ton of ore. These slimes are usually from ores with a gangue containing much colloidal matter," and the difficulty of treating them in the absence of the flotation method is well reflected by the name, with its implication of utter worthlessness—a survival of the days when these mineral mucks were the despair of all metallurgists.

It is evident then that granular matter can be treated in a very thick pulp, while the successful flotation of slimes demands a more dilute pulp. Of course the surface presented by a ton of slime is immensely larger than the surface of the particles in a ton of sand, so that more oil is needed in treating slimes. Furthermore, when the material is very finely divided it tends to gather into flocks, in many of which a number of gangue particles may surround each metallic particle, and these flocks must in some way be broken up as a preliminary to oiling and floating. A true colloidal slime resulting from pulverization of the clay-like constituents of the ore or gangue often proves extremely difficult to treat by flotation. Recent experiments made by a concern having a wholly intractable slime, however, indicate that addition of iron filings makes possible the formation of a good froth; and it is probable that the mere presence of any sort of granular matter would have a similar effect.

In general, flotation methods are applicable only to sulfide ores—in fact, it appears that it is the sulfur, rather than the metal, for which the bubbles possess affinity, and which therefore is responsible for the flotation effect. However, free gold, silver and copper can be floated, as can gold telluride; and where the cost of direct treatment is such as to justify the roundabout route, oxide ores can be sulfidized, after grinding, by means of solutions of sodium or hydrogen sulfide, and then floated. When carbonates are present in the floated ores the addition of acids causes the generation of carbon dioxide, materially aiding in froth formation; but in some cases the acid action upon ore or froth is such as to make this out of the question.

It is not to be supposed that flotation has superseded or will supersede older methods of concentration entirely, even in the case of sulfide ores. Thus the leaching process for copper ores produces metal for shipment, while flotation ordinarily yields only a high grade concentrate which has then to be smelted. Flotation can not, apparently, hope to overcome this handicap. Its great field seems to be in the direction of conservation, eliminating the slime losses at ordinary concentrating mills, and in general effecting concentrations which could not be accomplished under older methods.

Meeting the World's Shipping Shortage with Concrete Ships

NORWAY, Sweden and Denmark have already embarked on the construction of ferro-concrete vessels, and very extensive tests of this point have been conducted by the German Concrete Union, in the United States and elsewhere. One point that appears to be currently accepted is the unfavorable influence of lime in the cement, which is attacked by various ingredients in salt water such as magnesium sulphate. There are, however, varieties of concrete such as "puzzolane," which contain no free lime; also, if very dense concrete is used, it is not materially penetrated, and any decomposition is only a surface process. The chief precautions against prejudicial action of salt water appear to be: (1) The use of rich concrete, (2) the use of cement with little free lime, gypsum and alumina, (3) the addition of puzzolane, containing silicic acid to fix the free lime, (4) the use of coarse sand, (5) the use of dense concrete, (6) special surface treatment.

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American and European Plan

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Strategic Moves of the War, July 19th, 1917

(Concluded from page 58)

the British forces operating along the Mediterranean coast and will greatly aid in clearing the country to the south and east of the Dead Sea.

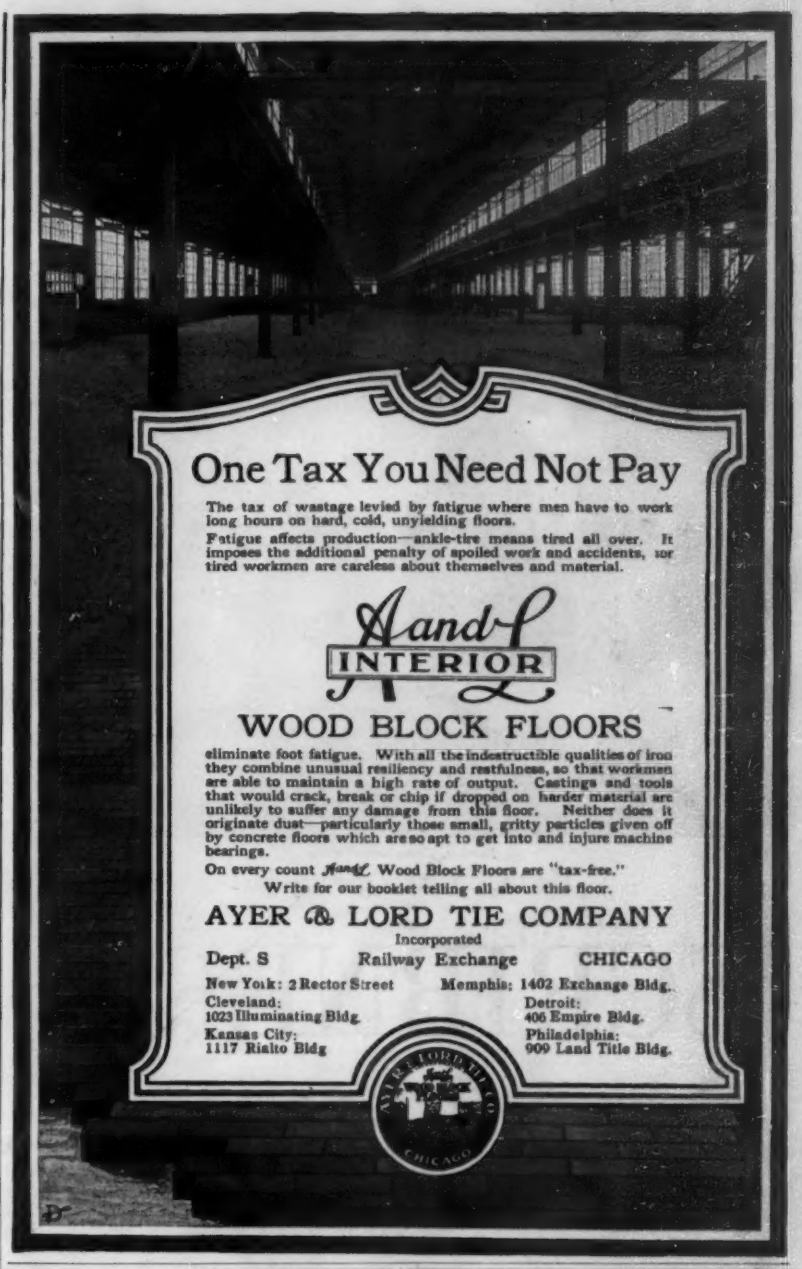
In Mesopotamia despatches mention the re-capture by the Turks of Khanikin on the borders of Persia and Mesopotamia; the right flank of the British forces operating on the Tigris is thus seriously exposed. This applies also to their lines of communications from Bagdad and must cause serious consideration concerning the possibilities of an advance until the road from Persia can again be opened to Russian coöperation. The terrible summer heat of the Tigris valley will no doubt delay any serious military operations until the advent of cooler weather.

There is every indication that Italy is about to undertake extended military operations and pressure against the Austrian lines in the Trentino and on the Carso front to prevent the withdrawal of troops to reinforce the shattered Austrian lines in Galicia. There is a renewal of fighting on the whole line but so far nothing of serious importance has occurred. If it be true that the German General von Falkenhayn is directing the Austrian-Italian campaign, it shows that Germany controls the Austrian military policies despite the strong peace sentiment throughout the dual monarchy. Information received in our country indicates that Germany treats Austria with very little consideration; her overbearing attitude has so irritated the Austrian people that a situation has been created which will tax Germany's powers to prevent serious embarrassment for herself. Austria is necessary to Germany as the connecting link for the latter's dreams as regards the near east and Asia Minor; therefore the former must remain as one of the Central Allies even if force should have to be employed to maintain the war union of the two empires.

Labor vs. Machinery in China

IN practically every country save China large scale railroad construction has been characterized by the employment of mechanical agencies. The successful contractor or engineer is the one who can replace the greatest number of human workers by dredges, scrapers, cranes, unloaders, and various crude and unusual types of machine designed for some special work peculiar to the job in hand. But in China it is otherwise. There the outstanding feature of track location and laying is that human labor is far cheaper than machines, that, consequently, thousands of laborers are employed for the big tasks which in any other land must be done by power or not at all.

It is the custom to employ as engineering chief, as auditor, as chief accountant, and as engineers in superior charge, foreigners—which is to say, whites. The subordinate engineers and overseers are native Chinese so that on the subdivisions of some fifteen miles there is usually but one white man to be found, the engineer in general charge. The labor is often supplied under contract by a class somewhat analogous to landlords or padrones. Even the work of grading and transferring material for grading is thus done by hand, coolies carrying the rock or gravel, in baskets, for which labor they receive some twelve to fifteen cents, gold, per day. In fact, so ridiculously cheap is human labor that even the material excavated from bridge caissons is thus transferred back to the approach fills, while one-ton hammers operated by hand laborers are employed for driving piles. A competent American railroad man with much Chinese experience estimates that the cost of removing earth embankment by man power, with an average haul of a 1,000 feet, is but three and one-half cents per cubic foot. Small wonder, in face of these figures, that Chinese railroad construction employs machinery only in bridge building and other places where it is a physical impossibility for the coolie to do the work with his hands.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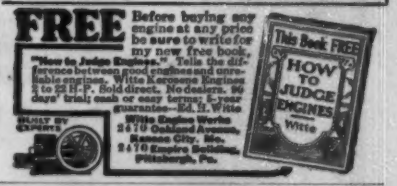

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We shall be pleased to give our unbiased, free opinion as to the probable patentability of any invention, provided a sketch and a description disclosing the same are sent to us. A distinct advantage possessed by our clients is found in the notice which each patent taken out through our office receives in the *Scientific American.*

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Will you think or pay? The Nation creates all land values—justice demands their use for National Defense—not for private gain. Tax on land values alone with no other taxes whatever will provide entire annual national budget—even five billion dollars. Will force idle land into use. Increase crops. Stimulate industry. Reduce taxes for 95% of the people. Will not raise prices or reduce production.

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He took it as a great joke!

SCRIBNER'S

THAT smiling flyer standing in front of his aeroplane has just crashed into the ground at sixty miles an hour. But so strong is the construction of this latest type of French fighting-machine that the damage to it was very slight and the aviator was unhurt.

Carroll Dana Winslow, author of "With the French Flying Corps," has just returned with the intensely interesting photographs which are published for the first time in "The Latest Types of Fighting Aeroplanes" in the August Scribner's.

You will see the newest automobile anti-aircraft gun, the most recent French bombing-machine, a German air-fighter which climbs 15,000 feet in less than twelve minutes, and a profusion of other photographs and data.

And yet this is only one feature of an issue which also contains John Galsworthy's latest short story, "Defeat"; other fiction by Henry van Dyke, E. H. Sothern, Gordon Arthur Smith, and Katharine Fullerton Gerould; and such important articles as "What the Council of National Defense Is and What It Has Done," by Grosvenor Clarkson, secretary of the Council, and Alexander Dana Noyes's timely financial and business comment.

Do you know who they are?

Winslow

van Dyke

Galsworthy

Sothern

Frost

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Booth

FOREIGN COMMERCIAL NOTES AND QUERIES

The SCIENTIFIC AMERICAN has always enjoyed a wide international circulation. Its voice is heard in the remotest corners of the earth. Now that American manufacturers have been stirred to the advantages of international expansion we are anxious to do our part in bringing American products into foreign markets. Hence this department has been established to pave the way for American trade expansion to all quarters of the globe.

Those who are interested in the trade opportunities listed in this column, can obtain the names and addresses by complying with the following simple rules: 1. Write only one inquiry on a sheet. 2. Always give the serial number. 3. Write on your own business letterhead. The SCIENTIFIC AMERICAN assumes no responsibility for the financial standing of concerns or individuals. Address all communications to the Query Editor of the SCIENTIFIC AMERICAN, Woolworth Building, New York.

588.—A firm in the United States with extensive connections throughout Latin America desires to be placed in communication with American manufacturers and exporters of automobiles, fountain sirups and supplies, bottlers' supplies, sugar-mill specialties, oil-well machinery, drills, etc., paints, varnishes, steel lockers, and gasoline. References.

589.—A man in Java is in the market for gold chains, rings, earrings, safety pins, and jewelry in general. Quotations should be made f. o. b. and c. i. f. destination. Payment will be made against documents. Correspondence may be in English.

590.—A merchant in Italy desires to purchase 5,000 to 10,000 tons of copper, electrolyte (99.8 per cent), Lake (99.8 per cent), Casting (98.5 per cent), in ingots, wire, bars, and cathodes (electro). Correspondence should be in French or Italian. References.

591.—A subscriber in South Africa is desirous of getting in touch with the maker of a good small tractor to take the place of a pair of horses. Locality is a large irrigation settlement and the farms vary from ten to fifty acres. The principal crop is Lucerne. The work is done by a pair of horses pulling a one-furrow plow. After mowing the hay has to be brought into the farm yard to be baled. The tractor to be used for plowing, mowing and transporting. The cost must be low and easily maintained.

592.—A subscriber in Arnhem, Holland, desires to become an agent for American houses for automobiles, electric motors, baking machinery, etc.

593.—Catalogues and price lists are desired by a man in Spain for machinery for weaving cotton and wool, electrical machinery and supplies, lathes for screw manufacturing, mandrels for lathes, electrical drilling machines, leather for bags, and rubber hose. References.

594.—A man in India desires to purchase wire nails, iron nails, brass, copper, galvanized-iron and iron steam pipes; brass and copper rods; flat, round and square iron; mild steel sheets; expanded metal; square and octangular galvanized-iron netting; galvanized-iron and iron pipe fittings; and all materials for ship chandlers in general. An agency is also desired for these products. Quotations should be c. i. f. destination. Payment will be made by thirty or sixty days' sight draft, D/P English currency. References.

595.—An import agent in Russia desires to be placed in communication with American manufacturers or exporters of pneumatic tires, ball bearings, tachometers, hubs, air pumps and lamps, chains for automobile trucks, and motor spark plugs for cars and airplanes.

596.—A firm in France desires to be placed in communication with manufacturers of thermos bottles, willow and rattan furniture, and baby coaches. Advertising circulars of the firm may be seen at the bureau or its district officers. Refer to file No. 2516.

597.—A man in French Indo-China wishes to communicate with American manufacturers of gramophone records for teaching languages.

598.—A company of electricians and power engineers in England desires to purchase electric motors. Specifications and full information may be had from the bureau or its district offices. Reference.

599.—A planter in the West Indies wishes to purchase fiber picking and cleaning machinery. All kinds of fiber-manufacturing machinery will be required later. Quotations should be made f. o. b. New York. Correspondence may be in English. Reference.

600.—An agency is desired by a man in Brazil for hardware, tools, agricultural and industrial machinery, inks, greases, oils, leather belting, and steel cabinets. Correspondence may be in English. References.

601.—An import company in France desires the agency for various American manufacturers. It wishes to purchase at present agricultural and industrial machinery and equipment; groceries, including canned vegetables, meats, and fruits; portable houses; tobacco; various raw materials; cements; paper and stationery; pencils, etc. Catalogues and samples should be submitted. Reference.

602.—Quotations are desired by a firm in Italy for dyes, oils, varnishes, etc. A complete list of goods desired may be had on application to the bureau or its district offices. Correspondence may be in English. Reference.

603.—A man in France is in the market for large quantities of quinine, etc., and pharmaceutical products in general. He also wishes to entertain an agency proposition. Quotations should be made c. i. f. destination. Payment will be made by cash against documents. Correspondence should be in French.

604.—A company in England desires to purchase ten to twelve ton lots of sulphate of alumina, seventeen per cent to eighteen per cent ground, and free from iron. Quotations should be made c. i. f. Manchester, if possible. Payment will be made by cash against documents in England. References.

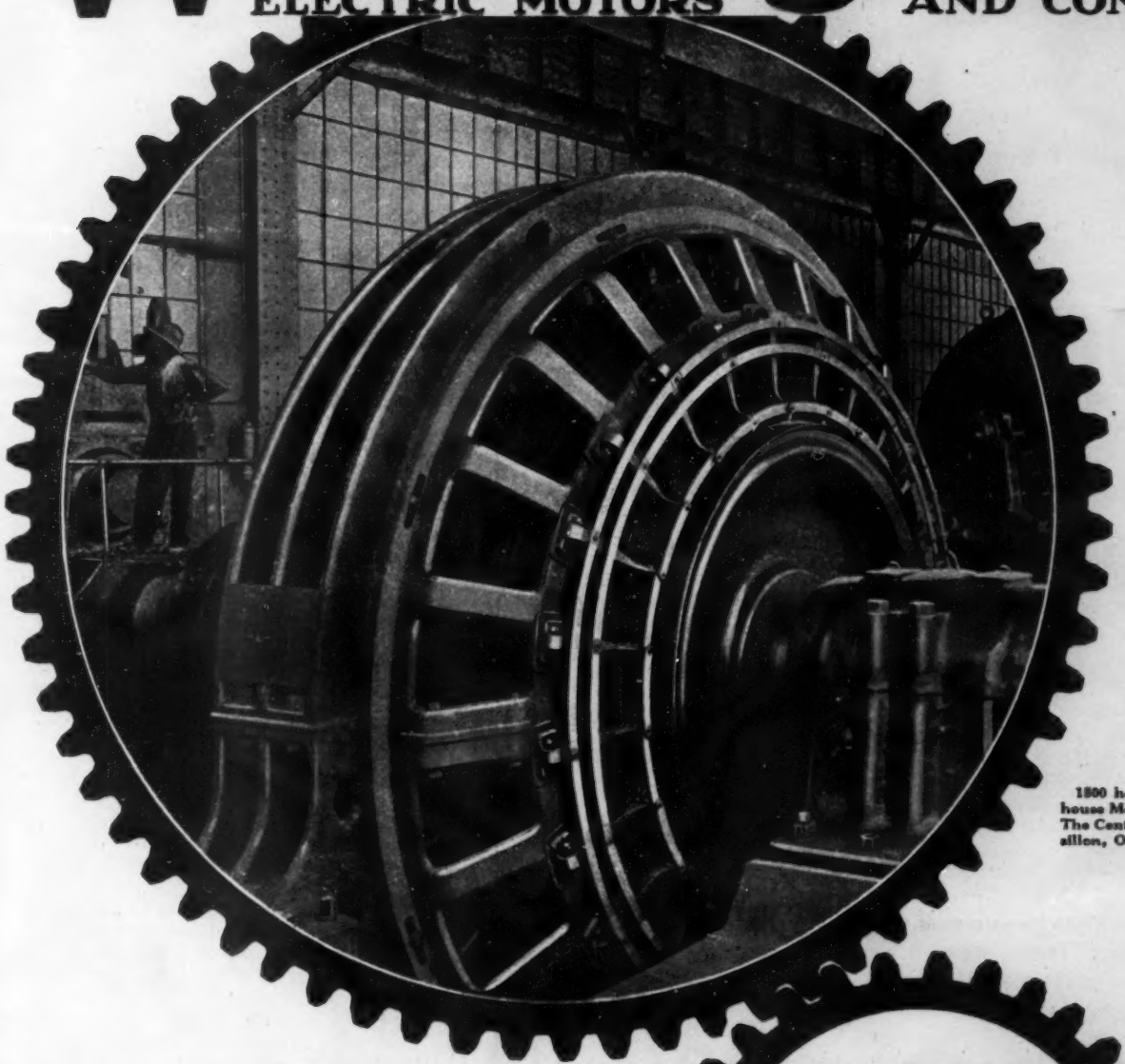
605.—A firm in French Indo-China wishes to be placed in communication with American manufacturers and exporters of sewing machines, scales, files, nails, sewing needles, sheet zinc, baled newspapers, oil cloth, aniline dyes, corned beef and canned fruits. Quotations should be made c. i. f. destination, if possible, otherwise f. o. b. American port. Payment will be made by sight draft against documents. Correspondence may be in English. Reference.

606.—Agencies are desired by a man in England for the sale of drugs, crude and refined, dyestuffs, dyes, chemicals, and all types of allied products. References.

607.—A firm in Brazil is in the market for all kinds of stationery and office supplies, bookbinders' supplies and machinery, and printing machinery and supplies. Quotations should be made f. o. b. New York. Cash will be paid against documents for initial trading. Correspondence should be in Portuguese or Spanish, preferably Portuguese. Reference.

Westinghouse

ELECTRIC MOTORS AND CONTROLLERS



1500 horsepower Westinghouse Motor in the plant of The Central Steel Co., Massillon, Ohio.

Geared for Any Load

For the heavy-going of the steel mill or the light pull of the washing-machine—

For the work that requires 1,500 horsepower or that which demands but 1-30 horsepower—

For any load, any speed, any service, there's a Westinghouse Motor.

There are literally hundreds of various types of Westinghouse Motors, each in many different sizes and with different characteristics.

Thus it is possible, with the right kind of engineering co-operation, to select for your job a motor that will not merely do the work but that will do it with the utmost efficiency. And a slight difference in design may mean a big difference in the saving of dollars to you

Westinghouse engineers will gladly co-operate with you or your engineers in the application of Westinghouse Motors to your purpose, whatever it may be, or in solving any problem affecting the generation, control, transmission or application of electric power. Their broad experience in answering all kinds of power questions will no doubt enable them to help answer yours.

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W
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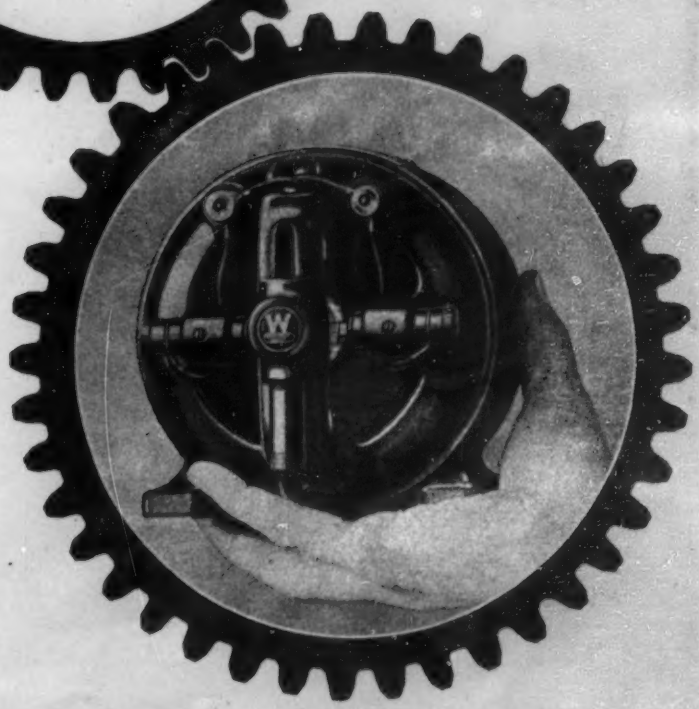

A Westinghouse Small Motor, such as is used to operate various appliances and devices requiring from 1-30 to 3 horsepower.

Through Service

Full-powered, like a giant locomotive, the MACK truck sweeps over the world's highways. It follows no prescribed track but moulds its routes according to the demands of transportation.

From Bethlehem, Pennsylvania, to Waterbury, Connecticut, the MACK truck rushed special steel to eager factories. In the Arizona desert, MACK trucks hauled materials for the Roosevelt dam. They carried cement and steel for the famous Catskill Aqueduct. A MACK, with a 10 ton casting for the Carnegie Observatory, climbed the steep road up Mount Wilson.

First manufactured twenty years ago, the MACK introduced the motor truck idea in the United States. Years of practical experience have brought refinements of design and improvements in construction, till today the MACK is the most endurable performance truck on record. In Los Angeles, a MACK truck has traveled 50,000 miles with an actual cost for repairs and parts of less than $20.00.

MACK capacities:—1, 1½, 2, 3½, 5½, 7½ tons.

Tractors, 5, 7, 11 and 15 tons.

INTERNATIONAL MOTOR COMPANY
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